E/CONF.39/A/152
22 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.4.3.3

Brazil

DISADVANTAGES OF SINGLE PHASE LINES ON PIONEER RURAL LINES

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Disadvantages of single phase lines on pioneer rural lines -

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1. Unbalance due to single-phase loads

The primary distribution in many countries has been accomplished by means of single-phase lines, with the recommendation, - considering the possibility of a future substitution for a three-phase line - that the project should be designed, so as to permit, for economical reasons, later on, a good use of the initial installations.

With a balanced three-phase load there are no serious problems of regulation, since this may be satisfied with the use of voltage regulators, the currents as well as the power, being always balanced.

Some remarks of substantial technical importance, should however be made aiming at the use of single-phase lines tapped off three-phase systems. In the strict sense of equivalence it is not possible to transform polyphase into single-phase power employing only transformers. The reason is that, single-phase power is characterised by the supply of "pulsating" energy, i.e., it varies periodically from zero to the maximum value; whereas a balanced polyphase power is characterised by a continuous supply of energy at a constant value. It is then evident that the transformation of a continuous supply of energy at a constant value, into a pulsating form of energy, or vice-versa, is not possible without provision for the kinetic storage and restitution of power.

It is clear therefore, that it is a waste of time to try to solve the problem employing special connections or

or arrangements in the transformers. Innumerable tentatives have been made, with results, which may be considered reasonable, having in view a balanced distribution of current when connecting single-phase loads to a polyphase system. But balanced "currents" do not signify balanced energy, and consequently do not mean smaller losses in the windings of the generator.

The resulting reactions and the effects of the unbalance of these currents lagging or leading have precisely the same effect in the energy-generating system as the single-phase load which causes the unbalance of the currents.

A correct method for obtaining, in the most favourable electrical conditions single-phase power from a three-phase system, is the use of a motor-generator set. In such a case a three-phase motor drives a single-phase generator and the single-phase load is obtained by the transformation of the electrical energy. In this method, we have complete "electrical" independence between the three-phase and the single-phase systems; it is therefore the ideal method, although more expensive.

2. Economical aspects of distribution lines

a) Cost of equipment of the primary line - Considering the first cost alone, and the investment for a given amount of power, a three-phase system is about 80% cheaper than the corresponding single-phase system. Such a conclusion may be easily reached by an identical analysis, as shown in item (b), relative to a secondary line.

This conclusion may not be valid if the conductor size dictated by considerations of regulation and efficiency is smaller than that dictated by mechanical considerations, which is not normally the case.

Examining the abacus, shown in the publication "Distribution Data Book", of the General Electric, it may be seen that, with a wire ACSR nº 4 of Copper-nº 6, a load of 500 kW, power factor 0,9 inductive, may be transmitted with a regulation of 5% over a distance of 12 km (7,5 miles) in a three-phase system at 13,8 kW.

Whereas, the single-phase transmission of this same amount of power (500 kW) at the same power factor and for the same efficiency and regulation, would be possible only for a distance not exceeding 6 km.

Wherefrom we can conclude that, only fro very small distances may the single-phase system compare favourably with the three-phase system for rural distribution; but the small distances are uncommon in such application.

There are, however, some cases where the single-phase system may appear to result cheaper than the three-phase system. The first is when a common neutral wire is used for both the high, and low voltage sides when they run along the same route.

But, besides this being rarely the case, and an unadvisable practice for many reasons, the saving is problematical

because :

- the neutral wire is quite unnecessary on the primary three-phase line; therefore it cannot be said that there is a saving of one neutral wire.

- this solid connection of the two neutrals over long distances, and varying conditions or facilities for proper grounding and its proper maintenance, may turn out to be a very expensive economy.

The second is the possibility of using the earth as a return for the single-phase lines, which is also not advisable as has been proved by technical investigation and experience.

b) Cost of secondary distribution -

Let V = voltage between phases, and I = line current then,

$$P = V I_1 . \cos \phi \qquad \text{(single-phase)}$$

$$P = V\sqrt{3} . V I_3 . \cos \phi \qquad \text{(three-phase)}$$

$$\therefore I_1 = \sqrt{3}\ I_3$$

For equal losses : $2 R_1 I_1^2 = 3 R_3 I_3^2$

$$R_1/R_3 = 3 I3^2/2 I_1^2 = 1/2$$

if the respective conductor cross sections are a_1 and a_3, we have :

$$R_1/R_3 = 1/2 = a_3/a_1$$

and for equal distances of transmission the weights of copper are $Cu_{(3)}/Cu_{(1)} = 3/4$, which results in a 25% economy in cost of conductor for the three-phase case.

3. Utilization and manufacture of single-phase equipment

There is no objection to the connection of single-phase low power (mostly domestic) appliances to the single-phase lines; this must however be avoided for larger power equipment of 10 HP (7,5 kW), and upwards, which should always be three-phase.

Let us consider in first place the equipments used for disconnection and protection, and afterwards those for consumption.

In order that the illustration should be convincing we hall compare a single-phase equipment with a three-phase equipment of the same power.

Taking, for instance, for the single-phase case, 15 kW at 220 V, the current will be 68 A; and for three-phase at 380 V, the current will be 23 A.

a) Circuit breakers

The single-hase circuit breaker needs two main contacts for conduct

conducting and interrupting the current of 68 A; whereas the three-phase one needs three contacts for 23 A. The energy dissipated in the contacts is inversally proportional to their area, or cross section; while their capacity of dissipation is proportional to their external surface. Consequently the weight of the contacts is approximately proportional to the current.

As the ratio between the number of contacts for single-phase and three-phase circuit breaker is 2/3, the ratio between the weights of each contact for single-phase and three--phase being 3, the ratio between the total weight of the single-phase and three-phase circuit breaker contacts is 2.

It results from this that the switching mechanism, for controlling the circuit and the operating springs (if any) have to be proportionally larger for the single-phase, because the volume of the component parts is approximately proportional to the current, for the sizes under consideration.

Consequently the circuit breaker for single-phase will have twice the weight and volume of that for three-phase; probably not quite so much, due to the diminution of space for insulation, since there are only two contacts, instead of three. A closer estimate might give a value of 1.5 or thereabout for this ratio.

With respect to the cost, as only the weight and wages affect it, the volume is of no importance. The labour costs will be only slightly greater for the three-phase, since the erection work requires a greater number of operations, but the smaller and lighter equipment can be easier manipulated. As a first approximation the total cost might be split as follows:

Material	45%
Wages	30%
General expenses	10%
Interest on the investment	15%

Taking the unit-value for the single-phase, and admitting that the labour for single-phase is only 80% of three--phase, we shall have :

	Single-phase	Three-phase
Material	45	30
Wages	30	37,5
General expenses	10	9
Interest on the investment	15	13,5
	100%	90%

That is to say, for the same power, the three--phase C.B. may cost only 90% of the price of the single-phase C.B. and occupyes only 67% of the space which is also of great economical importance.

b) Consumer's equipment

Relative to the consumers of energy we may point out some typical equipments, which represent important classes, i.e. :

- lighting equipment
- heating equipment
- motors

Lighting equipment, even if connected to three--phase systems, is always single-phase and therefore does not affect this discussion.

i) Heating equipment - Heating equipment can be single-phase or three-phase.

In the resistance type, the heat production is proportional to the square of the current, to the resistance of one element and to the number of the elements.

Suppose we have a three-phase heater, delta connected to the three-phase line, and a single-phase heater of equal power connected between phase and neutral of the same line.

Then, it can be shown that, in these conditions, the resistance of each phase element of the three-phase heater, is equal to 9 x resistance of the single-phase heater.

That is to say, each one of the three elements of the three-phase heater, having the same length as that of the single-phase heater, will have one ninth of its weight, consequently the total weight of the elements of the three-phase heater, will be one third of the weight of the elements of the single-phase heater.

The material of which these elements are made is of high cost; this is the reason why the single-phase heater is of considerably higher cost than the three-phase one; approximately, in the ratio of 2:1.

ii) Motors - Of all consuming devices unusually encountered in rural electrification, the squirred cage induction motor is without doubt, the one for which three-phase current is most suitable.

This because in the single-phase motor we cannot produce an even and symetrical revolving field which is intrinsec property of the three-phase windings, this resulting in considerable waste of frame space, only occupied by starting windings, which are not effective for continuous power development.

This naturally makes the single-phase motor more expensive, besides the complication of starting equipment.

The number of the conductors in series for one phase in a three-phase motor is :

$$N_3 = \frac{E_3 \ 0.97 \ x \ 60}{n \ \phi_3 \ C_3}$$

where

E_3 = nominal voltage

n = syncronous speed

ϕ_3 = magnetic flux

C_3 = winding factor

This winding factor varies but little, we may take its value at :

$C_3 = 0.665$

In the single-phase motor the number of conductors

conductors in series is :

$$N_1 = \frac{E_1 \quad 0.95 \times 54}{n \, \phi_1 \quad C_1}$$

where the winding-factor C_1 varies according to the design of the winding and it may be taken to be = 0.51

Assuming the single-phase motor connected between phase and neutral, and the three-phase motor delta connected, then:

$$E_3 = \sqrt{3} \; E_1$$

As the cross section of the magnetic circuit of the single-phase motor will generally be greater than that of the three-phase motor, we may take :

$$\phi_1 = 1.8 \; \phi_3$$

Assuming for the three-phase motor the efficiency and power factor of 87% and 88% respectively, and for the single--phase motor 80% and 70%, we have

$$\frac{I_1}{I_3} = 7.1$$

The N_1 conductors of the single-phase motor occupy approximately 64% of the total space for the slots; while the N_3 conductors of one phase of the three-phase motor occupy 33% of the total slot space; calling A_1 and A_3 the areas necessary for each conductor, in the single-phase and in the three-phase motor, respectively Aq_1 and Aq_3 the total slot areas required, we will have

$$\frac{Aq_1}{Aq_3} = \frac{0,33 \; N_1 \; A_1}{0,64 \; N_3 \; A_3}$$

For the same current density the ratio between the areas A_1 and A_3 is equal to the ratio between the currents I_1 and I_3; let the totalarea of the slots be the same fraction of the cross section between the inner and outer circles of diameters Do_3 and Di_3 in the three-phase, and Do_1 and Di_1 in the single--phase motor; we have then the relation :

$$\frac{Do_1^2 - Di_1^2}{Do_3^2 - Di_3^2} = \frac{Aq_1}{Aq_3} = 1.34$$

Assuming the same ratio between the inner and outer diameters of the stator, for both motors, we have :

$$\frac{Do_1}{Do_3} = 1.16$$

As we took the same magnetic induction, and the ratio 1.8 between the fluxes, this should be the ratio between the areas of the cross section of the magnetic circuits; calling L_1 and L_3 the axial length of the single-phase and three-phase motors, we have :

$$\frac{\pi \, Do_1 \, L_1}{\pi \, Do_3 \, L_3} = 1.8; \qquad \frac{L_1 \, Do_1^2}{L_3 \, Do_3^2} = 2.1$$

The number of conductors in the stator of the three-phase motor is $3 \, N_3$; for the same current density, the ratio between the weight of copper of the stator for the two motors, per unity of length, will be :

$$\frac{3 \, N_3}{N_1} = \frac{I_3}{I_1} = \frac{3 \times 2.73}{7.1} = 1.15$$

Calling $N_{1\,A}$ the number of conductors of the auxiliary phase of the single-phase motor, we will have, as a representative value:

$$\frac{N_{1\,A}}{N_1} = 0.8$$

Considering the ratio between sections of the conductors used in the main and auxiliary phase, the ratio of the weights of copper of the two windings will be :

$$\frac{N_{1\,A}}{N_1} \times \frac{1}{4} = 0.2$$

Therefore, the ratio between the weights of conductors of the stator per unit of axial length for the two motors, single-phase and three-phase will be :

$$\frac{P_{cu\,S\,1}}{P_{cu\,S\,3}} = \frac{1.2}{1.15} = 1.05$$

The ratio between the total section of the rotor conductors for both motors is the same as that of the stator conductors, without the auxiliary phase.

Thus, the ratio between the cost of the conductors of the two motors is approximately the same as the ratio between the respective lengths.

Besides these elements of comparison, we have to consider the equipment and arrangement necessary for the starting up.

The single-phase motor needs an automatic mechanism in order to disconnect the auxiliary phase at about 75% of the nominal speed.

Let us assume the same distribution of equipment costs as we have used in the analysis for the circuit breakers, and suppose that the iron and the conductors have the same influence on the cost accounting caming up 80% of the total material, the cost of insulation etc., being also in the same proportion as the respective volume; admitting also, that the automatic starting mechanism and the capacitor represent together 5% of the cost of material (a low value in any case). Thus, taking the cost of the single-phase motor as unit, we have :

	Single-phase	Three-phase
Conductors	0.4 x 45%	11.6%
Iron and insulation	0.55 x 45%	11.8%
Automatic and capacitor	0.05 x 45%	--
Wages	30%	15.6%
General expenses	10%	5.2%
Interest of investment	15%	7.8%
	100%	52.0%

As a final result, we see that the single-phase motor costs about twice as much as three-phase. This is further increased by the cost of the installation including the conductors, equipments and the devices for the limitation of the starting current.

It was shown that, for the same power, the three-phase circuit breaker costs only 90% of the price of the single-phase; here the difference is still greater, because, in spite of the fact that the capacity of the motors is the same, the power factor and efficiency of the single-phase motor are lower.

4. Influence regarding country development

The use of single-phase motors up to 1 H.P. (fractional horse power motors) is due principally to four factors :

- the fact that the employment of electrical machinery saves time and money;

- the convenience of using the initial distribution networks, which were designed for illumination service with incandescent lamps;

- the not too correct concept (originated 50 years ago) from the supposition that these small loads have no effect on the technical aspects of production, transmission and distribution of power;

the sufficiently good electrical characteristics, justifying the use of single-phase motors, when the existing installation is single-phase.

Of course, even in the present days, it would not be easy to justify the non-employment of these small motors, since they are already found everywhere as apparatus of domestic use.

Meanwhile, as we made clear above, the most advantageous aspect of the employment of three-phase motors is its favourable repercution on the electrical energy producing and distributing system, which is thereby used to the best advantage.

This important fact, is well born out by the discriminating tariffs, adopted by all supply companies, penalising in some measure, the single-phase loads which cause undesirable unbalanced loading conditions on the universally used three-phase transmission distribution systems.

Generators with special characteristics and equipped with damper-windings are generally employed to attenuate the effects resulting from unbalance. In some cases, of heavy unbalance, it will be necessary to employ generators, of low power factor such as 0.7 or 0.6. This results in a much higher cost for the generator and even then, the necessity for phase balancers may arise.

Rural Distribution is apt to be considered in a way a "necessary evil" at least from the point of view of the supply authorities, this because of its low rentability due to the low density of power consumption per km or km2 of area served.

It is therefore imperative to provide facilities for its utmost expansion, and not to limit its use by the small load capacity of inevitably expensive single-phase lines.

Thus, we conclude that for all the above reasons, the use of the single-phase lines should not be encouraged, preference being always given to three-phase distribution systems.

689 E - Oct.1962 - 1,600

E/CONF.39/A/153
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Agenda Item: A.4.2.3

China

OIL AND NATURAL GAS DEVELOPMENT IN THE PROVINCE OF THE REPUBLIC OF CHINA

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OIL AND NATURAL GAS DEVELOPMENT IN THE PROVINCE OF

THE REPUBLIC OF CHINA

by

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Geological Setting

1. The island of Taiwan is separated by a distance of 150 miles from the eastern coast of China mainland by the Taiwan strait. With the structural relationship of Taiwan to the neighboring island, Ryukyu at the north, Philippines at the south, it becomes an important link of the island arc chain around the border of the western Pacific.

2. Taiwan is a spindle-shaped island with its axis running NNE-SSW. Along the axis of Taiwan, lies a prominent central mountain range, 3,500 meters above the sea level, as the main water divide of the Island. The western slope of the central mountain range comprises the foothill belt table-land and the coastal plain near the Taiwan strait is comparatively wider and topographically gentler than the area of the eastern slope as well as the eastern coastal range bordering the eastern coast to the Pacific.

3. The central mountain range could be considered as an isolated block separated by two major longitudinal faults at both sides. It is constituted chiefly by the metamorphic Paleozoic, Mesozoic and the early Tertiary rocks. The pre-Tertiary is a highly complex series consisting of paragneiss, chlorite schist, marble etc. whereas the early Tertiary comprises Eocene, Oligocene slate and quartzite which were not so much altered as the pre-Tertiary.

Because of the intense complexity of the structure in the metamorphic zone, the chance of petroleum preservation seems not very favourable.

4. To the west of the major fault bordering the western slope of the central mountain range, the area running N-S includes the outcropped younger Tertiary belt of the foothills and the covered area of the low land. The whole western part of Taiwan forms a most important sedimentary basin to be explored for its oil potentialities. It is known from geological and geophysical studies that the major marine deposits of the Miocene, Pliocene and Pleistocene constitute a sedimentary pile thickened toward the eastern margin to about 8,000 meters and progressively thinning toward west. The genesis of the sedimentary wedge was probably due chiefly to continuous sinking of the eastern side of the geosyncline.

It is also characteristic in the geosynclinal deposits that in the north western part of Taiwan, shallow marine sediments are predominant whereas towards south, the open marginal sea deposits developed.

5. Uncertainty about the petroleum bearing rocks of Taiwan remains The major production is in the late Cenozoic sequence, oil and natural gas have been found mainly from the Miocene formation. In northern Taiwan, because the Miocene were deposited under the shallow marine environment, the reservoirs usually are clean and porous in the quartzose sand, and in the Post-Miocene formation in this region, no oil or gas has yet been found. In the southern region, the sediments become muddy and little oil is produced from the Miocene and some dissolved gas in the connate water has been found in the Pliocene formation.

6. The structure of the geosynclinal sediments is disturbed more strongly to the east near the major fault of the central mountain range, folding and faulting are displayed along the inner foothills belt. Structural deformations towards west near the Taiwan Strait.

7. The earlier exploratory drillings were mostly undertaken in the structure with Pliocene or Miocene formation outcrops at the surface and the results were very promising because of the structural complexity. Recently deep drilling has taken place in the gentle anticline, Chinshui, in the north part of Taiwan. Successful results of producing substantial amounts of natural gas in the deeper Miocene formation leads to hope that the petroleum potentiality will be promising if deeper drilling is carried out in the whole Miocene sequence in the gentle fold belt of western Taiwan.

8. Up to now, about sixty structures of interest for petrol research have been found in this Island, several of them already tested to shallow depth but the evaluation of their potentialities should be judged with the present new justification. Further exploration work should be carried out to the more structurally complex area of the eastern coastal range as well as the southern tip of Taiwan, where the oil possibilities in the Neogene sequence still exist but would wait until the exploration work of the sedimentary basin in the western Taiwan has reached a more advanced stage.

9. Petroleum and natural gas were incidentally discovered in Taiwan as early as 1817 in the vicinity of Chuhuangkeng, the present oil producing field in northern Taiwan. In 1861 the government of the Ching Dynasty started to explore oil resources by a very primitive method. No substantial result was achieved. Rather extensive petroleum exploration began in 1895. During the last half century seven meagre producing fields were discovered, some of them did not last very long. During the World War II the exploration and development of petroleum were inactive, only keeping the old fields in production at a declining rate each year. Since 1946 the geological field mapping and gravity meter survey has been conducted by Chinese Petroleum Corporation (CPC) at reconnaissance scale. Gravimetric survey has been carried out for about one year starting from 1946. The seismic reflection was introduced in Taiwan in 1955. At the beginning, one seismic party was organized with a Chinese crew and supervised by Japanese specialists at the expense of the Chinese Petroleum Corporation for about four months. When Japanese seismologists left Taiwan the seismic survey was carried out by CPC personnel. One seismologist was sent to Taiwan from the United Nations in a supervisory capacity to assist and supervise the seismic work in 1957. In addition a second seismic party was also established in 1957, and two sets of gravity meters were bought for assisting in the field work in 1959. The Geological department of CPC has been strengthened with micropaleontologic research and sedimentological study in 1955 and 1957 respectively. Photogeology is another instrumentation occasionally to be used in assisting, mapping geologic structure which may be favourable for trapping liquid or gaseous hydrocarbons. Photogeology is to be used in experimental stage.

RESERVE OF OIL AND NATURAL GAS IN TAIWAN

10. As mentioned in the previous Article most of the present producing fields are producing at a declining rate. It is hard to estimate the more reliable reserves of those old fields due to lack of usable data and information. However, the reserve of the newly discovered zones of Chinshui field can be calculated in more reasonable figures based on the available data obtained recently. Other structures are in an exploratory stage, so we feel it may be premature to make estimates of owing to the insufficient geologic and geophysical information available.

	Proved Reserve		Probable Reserve-	
	Crude Oil	Natural Gas	Crude Oil	Natural Gas
	kl	m3	kl	m3
Chinshui	3,832,900	19,495,000,000	5,710,000	34,020,000,000
Chuhuangheng	13,600	42,300,000	400,000	1,200,000,000
Chutung	---	29,900;000	---	128,000,000
Shantzechiao	1,500	200,000	100,000	13,000,000
Niushan	---	37,500,000	---	200,000,000
Chutouchi	680	23,800,000	300,000	132,000,000
Total:	3,848,680	19,628,700,000	6,510,000	35;693,000,000

The proved reserves of some old fields seem rather meagre in quantity, but the potentialities of some other structures are recognized to be very promising, quantitative figures may be given later.

Present Development

11. Chinshui Gas Field

(a) The Chinshui field is an anticlinal structure, the dips of both flanks are about 10-30 degrees, the eastern flank is slightly steeper, the rocks cropping out at the surface are Pliocene in age. There are 21 producing zones so far penetrated in the Miocene formations. At the northern part of the structure shallower zones have been developed and have been producing for about 50 years. However, at the middle and the southern parts which are now proved to be structurally high and prolific portions had not been tested and developed until 1960. Since the discovery of deeper pools of gas reserves from the deepening of well 38 in the Chinshui field in 1959, some exploratory wells have been drilled in the middle and southern parts of the anticline, and a tremendous quantity reserve of gas has been proved in Zone 13 and others. A major part of the Chinshui anticline has proved to be productive, especially zone 13 has been recognized as the most profitable and easy to reach (2,500 m. deep) the productive sand. Now there are four wells, two completed in 1960 and two completed in 1961, spaced at about 1,000 meters, available to produce from this zone. The average daily production of each of these wells is about 80,000 cubic meters of natural gas through 1/4 choke. Some crude oil associated with gas is produced, the ratio ranging from 1:20,000 (1 kl crude oil to 20,000 m3 gas) to 1:10,000.

(b) The deeper zones, 17 through 21, have been proved prolificly as evidenced by the drilling records of wells 38 and 52, which are spaced at 2.3 km distance. Well 38 could produce at least 100,000 m3 day from zones 17A and 18 at steady flow through double-choke. The bottom hole pressure of these two zones is reported approximately 7,3000 psi. Well 52 was completed at zone 20 and with a flow of 110,000 m3 natural gas and 4.5 kl crude per day through 1/2" choke by productivity test.

(c) It is scheduled to drill a total of 18 deep wells and 10 shallow wells for developing the deep and shallow horizons of this field. The production target has been set, at 1,500,000 cubic meters of gas per day after the completion of these wells.

Chuhuangkeng Oil and Gas Field

(a) The oldest producing field in Taiwan, Chuhuangkeng anticline, is situated at 17 kilometers south-east of the Miaoli city. The very prominent ropographic and geologic expression of the spindle shaped anticline shows its axis trending approximately NNE for a traceable length of about 25 kilometers, with a width of only 5 kilometers. Formerly 105 wells had been drilled along the west flank of the southern culmination. The total production of crude oil is about 220,000 kiloliters and of the natural gas more than 100,000 cubic meters. In the latter part of 60 years production history, it has declined to such a stage of depletion that only 23 wells remain producing with an insignificant amount.

(b) The flanks of the anticline are very steep. At the axial portion, the middle Miocene, Chuhuangkeng formation is exposed and a dip-slip fault developed along the axial direction which formed a curved fault surface that might have slipped along the eastern dipped bedding plane at depth.

(c) Based on the restudy of the geology of the anticline, structural sections and structural contour maps of the deeper horizons of the lower Miocene in the anticline have been made so that a deep well was decided to be drilled on the eastern flank and to the east side of the major dip slip fault. The total depth of the test well No. 106 is 3,561.60 meters so that the lower Miocene, Nushan formation for the first time has been encountered. The dips shown by the well-bore are nearly vertical close to the surface, and gradually become gentle, about 300 below the depth of 3,000 meters. This indicates the structure of a tightly folded anticline near the surface probably becoming gentler toward the depth.

(d) The newly discovered five gas zones in this well are within the depth range of 2,889-3,561 meters, which belongs to the lower Miocene Nushan formation. The producing zones are very tight sand, but the gas production estimated from the formation test might reach 80,000 cugic meters per day. The shut-in bottom hole pressure from the same test was around 4,000-6,000 psi. Chemical analysis of the natural gas produced shows 40% of CO2 and 60% of methane.

(e) The result of this deeper pool test in Chuhuangkeng structure has the significance that,

(i) The productive Meshan Formation has an extensive distribution in the deeper part of the structure, therefore many development wells should be drilled afterwards.

(ii) A wide distribution of Mushan Formation containing good reservoir sands and possible reserves of hydrocarbon exists in northern Taiwan. Deeper drilling of the favourable structure is necessary even if the shallower reservoirs were not productive by former drilling tests.

(iii) The Wuchishan Formation, a very good reservoir sand exposed at some places in the northern part of Taiwan underlies the Mushan Formation and has not been reached by No. 106. A little oil production has been found from this formation in the wells of the Shantzechiao structure. It is suggested that further deep drilling shall set its deeper target in the Wuchihshan formation in the expectation of production in addition to that of the Mushan formation.

(iv) The production test of the No. 106 well is mainly gas with only a very small amount of light crude and we are not certain now where the location of the well is in regard to the gas-oil contact.

Further tests should emphasize on this relation for the prearrangement of the reservoir energy maintenance of the production efficiency.

Present Utilization of Natural Gas and Crude Oil.

13. Natural Gas

(a) By using the natural gas newly discovered and produced from the Chinshui field as feeding stock and fuel, the projected area plant will produce 100,000 metric tons of urea and 45,000 tons of ammonia annually. With this 45,000 metric tons of ammonia, an additional 50,000 metric tons of urea and 160,000 metric tons of ammonia sulfate 30,000 tons of nitric phosphate will be manufactured annually in other fertilizer plants. It will directly benefit a great deal agriculture, and indirectly promote the economic development of Taiwan.

(b) Natural gas produced from the existing field is being used for fuel and raw material of industries and domestic fuels as well. It is anticipated such markets as well as the market for petrochemicals will be increased with the increasing of gas production in the days to come.

The United Nations' Assistance in the Field of Petroleum Resources Development in Taiwan, China

The government of the Republic of China appreciates very much the United Nations technical assistance on petroleum exploration. The petroleum experts such as petroleum geologists, seismologists and micropaleontologist assigned to Taiwan, Republic of China, have benefited a great deal from the petroleum prospectings.

327 E - Oct.1962 - 1,600

E/CONF.39/A/154
23 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.1.1

Australia

MAPPING UNDER PRESSURE

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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MAPPING UNDER PRESSURE.

by B.P. Lambert, Division of National Mapping,
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1. Australia was largely unmapped in 1945 when the Federal and State Governments agreed to form a National Mapping Council to advise on the techniques and co-operation of mapping and mapping surveys and the development of a systematic scheme.

2. The task reported on is mainly one of surveying and mapping the undeveloped or sparsely inhabited semi-arid and desert areas in the centre and west of the continent, plus a proportion of tropical forest country in the north and north east, a total of about 2,500,000 square miles. In these areas there is usually some time of the year suitable for air photography.

3. Within the space available it is possible to deal only with survey and compilation techniques. Map production follows modern procedures.

4. The immediate demand has been for:
(a) large and medium scale contoured maps required for specific developmental projects,
(b) a general national coverage of maps required for defence and administration purposes and for resources surveys and general developmental planning.

5. Large and medium scale mapping has been very extensive throughout the world; but there is urgent need of the second type in the undeveloped countries and for this the Australian approach and method should be of value.

BASIC PRINCIPLES AND PROCEDURES

6. Certain basic principles have always been borne in mind:
(a) the most desirable form of presentation of topographic data is a full contoured topographic map.
(b) All such maps must fit together into one homogenous pattern over the whole country and so must be based on a national geodetic survey.
(c) Topographic data for any purpose should promptly provide as much information as possible.
(d) A very large number of map users can make use of planimetric maps with an indication of relief and do not require portrayal of relief in measurable form.
(e) There is always a continuing need for map revision.
(f) A continuing improvement can be expected in surveying and mapping

equipment and techniques.
(g) For greater efficiency large areas should be tackled instead of small isolated priority areas.
(h) If work is organized in successive stages: air photographs, uncontrolled photomaps, planimetric maps and contoured maps, instead of attempting production of fully contoured topographic maps, then: (i) the final overall contoured maps will be produced in much the same time; (ii) earlier provision of topographic information is possible in respect of the whole country; (iii) this can be used in resources surveys and developmental planning and in planning subsequent geodetic and topographic surveys; (iv) progressive "on the job" training of staff is possible; and (v) the latest technical developments become available at the more complicated stages of the work.

8. Consideration of these principles has led to adoption of the following procedures:
(a) an assessment and timely review of the overall basic national requirement for fully contoured maps and the continuous consideration of this requirement as a background to the more expedient mapping activities;
(b) agreement on the basic plan of National Geodetic Survey necessary for the ultimate topographic mapping requirement;
(c) the provision of an early nation-wide coverage of air photographs;
(d) the preparation and distribution of uncontrolled photomaps as soon as photography is available;
(e) a phased programme of mapping aimed at: (i) the complete coverage of Australia with 1:250,000 scale maps; the first edition of which will be a planimetric series; the second edition of which will be a fully contoured edition with the early planimetric detail revised to the date of re-compilation and adjusted to fit to the National Geodetic Survey; (ii) subsequent production of 1:100,000 scale fully contoured mapping of areas of special developmental interest; and (iii) the early commencement of geodetic survey and so arranging this that requisite control data is available in advance of the later phases.

CONTROL SURVEYS

9. Horizontal Control. Initially a large number of astro fixes were observed by small mobile parties using second order theodolites and aural time reception techniques. This programme should terminate during 1962.

10. The provision of horizontal geodetic control is currently proceeding apace on the basis of first order Tellurometer traverses controlled for azimuth by frequent Laplace observations. It is hoped to organize, by the end of 1965, a major network of traverses so that no point in the remoter areas is more than 100-150 miles from a first order station and no more that 50-100 miles from such a station in the more settled areas.

11. For the "second edition" it is planned to extend horizontal control by, depending on circumstances, either the aid of airborne "Aerodist" equipment or rapid second order Tellurometer traverses supported by helicopter transportation; with the object of providing a suitable grid pattern that will control subsequent "block adjustment" by photogrammetric methods; a procedure to be well established by the beginning of 1966.

12. Vertical Control. Some precision levelling is being undertaken but it is planned to cover the country in the first instance with a basic network of third order levelling which should provide ample accuracy for subsequent operations.

13. In the course of Tellurometer traversing vertical angles are observed. Resultant calculated heights have a standard deviation of ± 3 feet.

14. In the planimetric mapping phase an attempt is made to get enough spot elevations to allow of approximate contouring for the I.C.A.O., 1:1,000,000 series.

15. When obtaining astro fix control and in the course of identification surveys, field parties carry out long range barometric heighting using aircraft type altimeters grouped in portable batteries and working within the national meteorological net work of fixed mercury barometers. The results of this work are considered to have a standard deviation of ± 50 feet.

16. The elevations of some hill tops are determined barometrically with the aid of helicopters while others are established from the mean of several altimeter readings taken in the course of close passes by light aircraft. These latter probably have a standard deviation of ± 200 feet.

17. In preparation for the second (contoured) edition more accurate barometric heighting is under way, a considerable amount of this work having been aided by helicopters working between level lines about 50 to 100 miles apart and the resultant elevations appear to have a standard deviation of ± 10 feet.

18. An Automatic Radar Profile Recorder is being used experimentally.

PHOTOGRAMMETRIC SURVEYS

19. Air Photography and Photomaps. Air photography, which now covers almost all Australia, has, in conjunction with photomaps, been useful in exploring unmapped areas, and probably a major factor in the spectacular discoveries of mineral resources in recent years.

20. The demands of resources investigators for large scale photographs have been resisted and most initial photography has been taken at altitudes of about 25,000 feet.

21. In the early stages, six inch, wide angle lens cameras were used to give a considerable coverage of 1:50,000 scale photography but in recent years three and half inch super wide angle lens cameras have been used very satisfactorily to provide 1:84,000 scale photography.

22. Photography for Federal Governmental agencies is contracted out to commercial air survey firms. Where subsequent 1:100,000 and possibly 1:50,000 mapping is intended, re-photography is likely to be arranged using the super wide angle camera and simultaneous Radar profiling from a height of 25,000 feet.

23. Photogrammetric Compilations. At present, slotted templates are used in conjunction with astro fixes, or astro fixes combined with geodetic survey, to give planimetric control positions. In the early stages requests for special priority areas had to be met, unavoidably. Efficiency is obtained by assembling large areas at the one time.

24. With wide angle photography detail is filled in with the aid of "sketchmasters" but with super wide angle photography in other

than flattish country the "Stereotope" is used for planimetric plotting.

25. Original compilation sheets are prepared at near photo scale and advance copies are supplied to resources investigators for plotting of their data direct from photographs.

26. It is considered that quite an amount of useful contouring for scales of 1:100,000 and smaller will ultimately be done with the simpler type of stereo plotter. However, it is hoped that by the time contouring starts in earnest, electronically controlled contour plotters will be well established.

27. Field Checking and Current Revision. When compilation is completed a field identification survey is carried out from a light aircraft fitted with a small air survey camera. Anything to be added to the compilation is photographed, matched to the basic photography and then plotted on the compilation.

OUTPUT

28. Geodetic Survey. Rates for Tellurometer traversing have varied from 30 to 100 miles per man/year depending on transportation and terrain difficulties. On the average about 5 Laplace stations are completed per man/year.

29. Photogrammetric Survey. Rates have improved from about 3,000 square miles compiled per man/year to 4,000 square miles per man/year. Future use of super wide angle photography should lift this output to about 6,000 square miles per man/year. The ratio of field to office staff is about 1 to 2.

30. If a start were now being made on mapping Australia much the same practices would be followed but air photographs would be taken by cameras equipped with the super wide angle lens; radar profiles would be made simultaneously with this photography; initial astro fix control would be limited to a wide grid net work and templates would be assembled on the basis of a "Jerie" technique modified to suit graphical adjustment.

31. The same practices would be adopted for early production of photomaps and the phasing of geodetic control surveys and planimetric compilation to be brought to such a stage of completion as to permit of a smooth flow into the final phase of contoured mapping. At that stage, it is hoped, electronically controlled contouring equipment will be available.

1181 E - Oct.1962 - 1,600

E/CONF.39/A/155
23 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A.3.1.3

Turkey

ADAPTATION OF WATER LAWS OF TURKEY TO CHANGING CONDITIONS AND HER BILATERAL AGREEMENTS ON INTERNATIONAL STREAMS

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ADAPTATION OF WATER LAWS OF TURKEY TO CHANGING CONDITIONS AND HER BILATERAL AGREEMENTS ON INTERNATIONAL STREAMS

by

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A. INTRODUCTION

1. Before going into the subject matter of the paper it is deemed worthwhile to repeat here the aim of the Conférence, which consists of bringing together, comparing, and discussing various methods used in the present science and technology for providing fast economic development in underdeveloped countries, and bringing to the attention of the Governments those methods which are found to be applicable.

2. In this paper particular attention is given to some important legal provisions on water rights which are incompatible with the development of water resources under a modern policy and effective program, when it is desired to develop these resources which form one of the most important among the natural resources of Turkey. One such provision is contained in the Expropriation Law. It states that any source of water can not be expropriated in the name of the public interest. Another provision in the Turkish Civil Code considers water springs and ground-waters to be complementary parts of the land, and states that their ownership is transferred together with the ownership of the lands where they occur. A third obstacle consists of a great collection of documentation of ancient origin in the form of water rights and powers granted by Sultan's decrees, old court decisions and cadastral records belonging to the times of the old regimes dating as far back as the period of the Ottoman Empire, which are still in force. Another important obstacle is the lack of an agency with clearly defined authority to perform services in the regulation and control of the development of water resources and intervention in and adjustment of the disputes arising in connection with the development of the water resources.

3. This paper describes the changes already made or planned to be made in the laws and regulations of the country, how the above provisions and obstacles, which are unsuitable for a modern development policy, were changed or overcome, and discuses the resulting social and economic benefits.

4. There is also the question of the rivers in Turkey which form the common boundaries with the neighbouring countries, or whose upper courses lie in Turkey while their lower courses lie in other countries, or the other may around. Serious difficulties and problems are encountered in the development of these rivers because of the lack of an agreement with the country in question or the shortcomings of some of the existing agreements.

5. In order to prepare the background for the development of water resources according to scientific and technological principles in speeding up the economic development of the country, it is recommended that the public should be educated in this respect, personnel should be trained in sciencific and technological subjects, the legal authorities should show an understanding of the conceptions on the solution of the exigencies and the remedies, and finally, the politicians should defend these conceptions and make possible their going into effect by passing the legislation needed.

B. BASIC LEGAL CONCEPTS ON WATER RIGHTS

6. Before discussing the existing provisions in the laws of Turkey which are incompatible with the development of water resources in a modern way, it will be of special interest to study three universal laws that are inherent in the existence of all creatures. In nature these laws concern self-preservation, continuation of the species, and the changes brought about through the process of evolution.

(a) Rights of the individual for self-preservation

7. The strife for self-preservation derives its sources from the making of all creatures, It drives human beings to earn money, to look for food and shelter to protect their health, to provide rest for their bodies and minds , to struggle for success, and the last but not the least, to own material things including natural resources.

8. Water plays a vital part in the existence of life in all its forms. In the case of human existence it is needed to keep us alive, to keep us clean, to irrigate our crops. Besides being essential in some areas, irrigation provides in some cases times more crop in other areas if practiced. Water also serves to operate our flourmills and manufacturing plants.

9. Water being one of the most important needs for the self-preservation of the individual, it became also of equal importance for the families and villages which constitute the smallest unit in the social structure. Therefore , according to the law of self preservation, it is in the nature of human beings to struggle to acquire and keep the ownership of a source of water which gives him and his family, and his village the livelihood for which everyone strives.

10. It is believed that there are legal provisions in other countries as in ours which are established to protect the ownership of water resources by individuals or villages and which were born out of the conceptions and doctrines of the old times when the law of self-preservation of the individual prevailed without the controls and balances later introduced. These provisions of the other countries are probably similar to these in Turkey which are in the form of Sultans' decrees, very old court decisions and cadastral records, and the provisions in Article 679 of the Turkish Civil Code which assures that " water springs and ground-waters are complementary parts of the land, their ownershi is transferred together with the ownership of the land where they occur ."

(b)Continuation of the race

11. The law urging the human beings in the path of the continuation of the race is the second strongest after the law of self-preservation of the individual. It manifests itself in the attraction between the sexes, the desire to form families, and have offsprings. Everything stated with respect to the first law also holds true for this one. Therefore, the protection of the acquired rights of the individual and the urge for the self-preservation of the individual also indirectly serve the fulfilment of the requirements of the continuation of the race.

(c)Changes dictated by the process of evolution

12. As is well Known, the direction of the evolutionary process is away from egotism and toward altruism. The forces which help to create human society originate in the minds of individuals through evolutionary processes in the form of desire and ability to live together. The revelations of truths in the forms of inspirations that dawn upon some gifted individuals in human society eventually spread to produce changes in the texture of the society. These changes are as a matter of course aimed towards the advancements of human beings and the improvement of relations among them. This is a result which requires many years, but there is not slightest doubt that further advancement will continue to take place in this way as it did in the past.

13. The protection and continuation of acquired rights is only justifiable where the water resources are plentiful and in excess of the needs of the society. Where such conditions do not exist, in order to comply with the requirements and dictates of the process of evolution such rights which may exist should either be restricted or replaced by new ones which are in harmony with the principles for the development of water resources in a modern way. Under the above considerations it is believed that evolutionary process manifests itself in the workings of the present Congress, for which unlimited appreciation is due to its organizers.

C. OLD LAWS WHICH RETARD THE EFFICIENT DEVELOPMENT OF WATER RESOURCES.

(a) The Expropriation Law

14. There are many instances in Turkey where town and village are located close to each other and where the villages have an abundant source of water which is utilized for irrigation after meeting the drinking and household needs of the village, whereas on the other hand, the population living in the town suffers from the lack of adequate water supply to meet its normal requirements. In such cases, without the consent of the village people the municipality of the town is not able to utilise the excess water through expropriation because the Article 1 of the Expropriation Law No.6830 states that only the real-estates and sources of water which are privately owned may be

expropriated for projects involving the public benefit. In other words, water sources which are under the ownership of judicial persons or public institution cannot be expropriated.

15. The lawmakers have provided a solution for a particular case involving the latter group in Article 30 where it is stated that when the use of a source of water owned by a public judicial person or a public institution is needed by another public institution than it is recommended that they should try to reach a compromise and, in case they fail to do so, the matter should be decided through the arbritration of the Council of State. However, it has been declared by the Council of State that the rules and regulations did not permit the transfer of the rights on a source of water from one public institution to another on the bases of the justification, as expressed in their decision under combined legalopinion (No.53/7-53/23), to the effect that " the use of the expropriation powers of the public intitutions against each other would be to the detriment of the public services." It becomes evident, therefore, that the municipalities cannot provide water for towns in an economical way. But in view of the well established principle which requires that the planning of the development of water resources in a region should be carried out in such a way which will make it possible to meet all the needs of that region under the most economical solution it becomes necessary that the abundant water supply of a village in a case similar to the one mentioned above should be first transferred to the ownership of the State and that all the reasonable requirements of both village and the town should be met according to the solutions reached as the result of planning studies.

(b) The Articles 679 of the Turkish Civil Code on the ownership of springs

16. The text of this article is reproduced here as follows:
"A water spring is a complementary part of a land and its ownership is transferred together with the ownership of the land. The right to use a spring located in the lands of others is established by entering it in the cadastral records as a right of use. "The ground-waters are considered the same as springs." According to the provisions in this article all surface waters and ground-waters/the lands which are under ownership are considered to be the property of the owner of the land without giving any consideration to the sources, quantities, qualities, and the means of the replenishment of such waters.

17. But the surveys and studies made in recent times have shown that the origines of water springs and ground-waters are not related in any manner to the boundaries of the lands where they occur and that they actually originate under various factors which exert influences in areas much larger in size. Accordingly, it is reasonable to suggest that such waters should be considered to be belonging to the general public. Only then it may become possible to consider their development in a scale compatible with modern planning activities. Otherwise, only because of this particular article large difficulties will continue to prevent the development of these water resources for the public benefit as required by science and technology.

(c) Old water rights

18. In the old times some influencial and enterprising persons (a local chief or landowner) with the intention of personal gain have established ownership over water springs either by obtaining a decree from a Sultan, a document from a court, or by having such ownership entered in cadastral records, and thereby created rights over water springs as well as powers to regulate irrigation practices to be applied, In the light of the present laws and practices these are considered ancient rights but they are inviolable.

19. In areas where such ancient rights exist it is not permissible to carry out any development which may affect the quantity or the quality of the waters of these springs, such as by making excavations, planting trees, erecting buildings, etc. It is not possible to bring out local possibilities through a change in the status by obtaining a court order even if these living in the neighbourhood may be more in need of water than the present users, even if such need assumes a vital importance. Such old water rights are also inviolable at the present to actions of administrative authorities.

20. This system is also clearly detrimental to the development of water resources for the benefit of the public and it forms a serious obstacle in the way of the application of the principles of modern planning. As a matter of fact, when the origin

of these old waterrights and the nature of water resources are considered, it is seen that this system is also incompatible with the principles of social justice and that it needs intervention, change, and adjustment.

D. AFFECTED AND PROPOSED CHANGES IN THE LAWS OF TURKEY FOR FACILITATING SOCIAL AND ECONOMIC DEVELOPMENT.

(a) The new law on village water supplies.

21, This law was passed on 9 May 1960 under No. 7478. The article in it concerning "the allocation and distribution of drinking-waters" is related to our subject (Article 11.) In this article the Directorate General of State Hydraulic Works is authorised to allocate and distribute or alter the existing methods of allocation of all sources of water according to the drinking-water needs of villages and inhabited places. This article also contains a provision which clearly states that the existence of documents in the form of Sultans' decrees or court decisions giving the ownership of a source of water previously to one or more villages shall not affect the application of this article and that the application of expropriation measures is not needed.

22. The justification for this article was provided by the previous experience in which there occured many so-called "disputes on sources" under the then existing provisions which used to cause many villages and towns to remain without a source for water supply or used to create delays in the carrying out of projects. However, this article applies to the cases of villages only where it helped stop "disputes on sources", but the situation in towns and cities still continues as before.

(b) The new law on ground-water.

23. This law became effective on 16 December 1960 under No.167. It may be considered a step forward in preparing the way for the application of the principles for the rational development of water resources. The first article of this law states that the ground-waters are public property under the ownership of the State. The other articles state that ground-waters shall be under the control of the Directorate General of State Hydraulic Works, who is authorized the prevention of wasteful utilization of ground-water resources, the regulation and adjustment of their development, the guidance and regulation of the ground-water porjects undertaken by the private sector for the purpose of preventing investments in doubtful projects.

24. For bringing together in a single agency all the data concerning all the work performed on ground-water development, documentation, filling, and recording services were established. Regulations were prepared and put into effect beforehand for the utilization of ground-waters in order to prevent future disputes related to acquired rights and concessions for ground-water development which is advancing rapidly.

(c) Amendment made to Article 679 of the Turkish Civil Code

25. The text of the Article 679 of the Turkish Civil Code was given in Paragraph 16 above. The part of this article stating that "Ground-waters are considered the same as water springs," has been changed by the Amendment No. 138. dated 23 November 1960, to read, "Ground-water are generally among waters for the public benefit. Ownership of a land does not carry with it the ownership of the ground-waters beneath that land. The procedure and the degree according to which the owner of the land shall utilize ground-waters shall be determined by the applicable laws, " This change was made for preparing the way of the provision making ground-waters public property in the Law on Ground-waters which was being proposed at the time so that it would not be in contradiction with this article of the Civil Code.

26. The justification for considering ground-waters public property may be stated briefly as follows: In the recent times knowledge on ground-waters has undergone revision and expansion. It was established that voids and caverns in the layers of various underground formations contain ground-water either in the static state or in motion, and that whenever ground-water flows to the ground surface, either by pumping

or by artesian pressure, this action produces changes in the whole area covered by the volume of the ground-water storage. Because the extent of the area influencing the formation of a ground-water reservoir is much larger and has a more complicated shape than that of a watershed involved in the formation of surface streams, the ground-waters cannot be considered to be related to the Lands under which we might happen to find them, and they cannot be said to form "a complimentary part of the land " as was previously believed. They should, threfore, be accepted as being public property in every sense. As ~~the~~ result of this change made in the last part of Article 679 of the Civil Code it became possible to utilize ground-waters for meeting the public demand under equal conditions and to serve the development of the country.

(d) Porposed laws for the development of water resources.

27. At the present time there does not exist in our country a separate law on the development of water resources and only minor relevant provisions are included in various legislation. But it is required naturally that a legislative system conforming with the principles of modern development should be in effect in order to provide for the optimum utilization of water resources in the country and to use these resources for public benefit and economic growth.

28. Because such a legislative system is lacking at the present the situation may be described by citing the following disadvantages which result :

(i) Wasteful use of water,
(ii) Uneconomic development resulting from scattered and separate utilization,
(iii) Difficulties encountered for the utilization of water mainly for the public benefit with due regard to basic rights,
(iv) Inadequate application for the measures against pollution,
(v) Irresponsibility on the part of the users during operation and maintenance
(vi) The lack of an agency which is clearly authorized to carry out general planning for the development of water resources,
(vii) The lack of an inventory of public water resources,
(viii) Indefiniteness of the provisions contained in ancient water rights which result in many disputes.

29. For removing these disadvantages and deficiencies a draft was prepared for a proposed new law entitled: "Law on the Development of Water resources." When passed, this law will establish a legislative system under which it will be possible to meet the requirements of the people and help the advancement of the country by aiming at the utilization of the water resources in conformity with the democratic system established by the Constitution. This draft law provides that all water resources belong to the State because they are closely related to the interests of the public, and that private persons may be given the right to use resources when they receive a license from an authorized agency. It will then be possible to initiate and keep an inventory of water utilization.

30. Also, this draft law defines the responsabilities of the agencies and the users in order to provide for economic development and maintenance of hygienic qualities, and to make possible that the requirements of the public are met adequately. There are other provisions in it concerning the performance of public services such as quality control, pollution abatement, flood control, shore protection, operation and maintenance, etc. One of the other items is aimed to provide clarification on the authorities and responsibilities of the agencies in carrying out the planning work for the development of water resources and on the basic principles to be applied in these activities.

E. AGREEMENTS ON INTERNATIONAL STREAMS

(a) The article 109 of the Lausanne Traty (1923)

31. After the First World War the International boundaries drawn between Turkey and her neighbours Iraq and Syria resulted in the partition of certain streams whose upper and lower courses remained in the territory of a different country. The Lausanne Treaty, signed on 24 July 1923, contains an article which forms the basis for negotiating and settlement of international disputes which may arise during the development of such international streams. The text of this article is as follows:

"Article 109 - Unless there are provisions to the contrary,when, as a result of the establishment of a new boundary, the water regimes (canal systems, floods, irrigation, drainage , or similar matters) in a country become dependent on works constructed in the territory of another country, or the waters or water power originating in the territory of a country are to be used in the territory of another country by virtue of the practices established prior to the war, then the countries involved shall enter into an agreement which will guard the interests and acquired rights of each country and in case of failure to reach an agreement the matter shall be decided by arbitration."

(b) Agreement with U.S.S.R. on the Arpaçay (Harpasus) and Aras (Araxes) Rivers (1927)

32. This agreement,signed on 8 January 1927, contains provisions for the development of the streams which form each stream by the two countries in equal amounts. According to this agreement, the two countries concerned may each establish gauging stations for water level and discharge measurements, or they may establishe such stations jointly. If the necessity arises, each party may divert water for irrigation by constructing diversion-dams or may provide water storage by building dams. Each party may also construct hydro-electric power plants and flourmills and , provided that each party does not exceed his share of the water, they may each build pumping plants. It is mutually agreed that each party shall take appropriate measure on his side for the stabilization of the line of river bottom (talweg) which forms the common boundary. The definite location of any structure proposed by either party or jointly by both parties is to be selected and established by a Joint Commission. In the case of a disagreement in the Joint Commission the final decision is to be left to the Governments

33. The rational development of the Arpaçay and Aras Rivers to serve the peoples of the both countries concerned is progressing in accordance with the provisions of this agreement under the goodwill shown by both countries.

(c) Agreement with Greece on the Meriç (Evros) River (1934)

34. This agreement has a limited purpose consisting of the coordination of the hydraulic works to be built on both sides of the Meriç River, which forms the common boundary, for the stabilization of the line of the river bottom (talweg) by constructing works on both sides protection of the banks of the river. It is mutually agreed to construct longitudinal levees on both sides to protect the valley against floods

35. A development plan for the whole valley was prepared by the Harza Engineering Company of Chicago during 1950-52. The part of this plan involving flood control works was carried out by both countries since 1955 and the valley is now protected against this threat. However as the development of irrigation and drainage is not covered by this agreement, the parts of the plan concerning these objectives has been slow in realization.

(d) Protocol with Iran on the Sarısu River (1954)

" 36. The Sarısu River, a tributary of the Aras River,emerging from a small lake in the west of the town of Doğu Beyazıt in Turkey, enters Iran where it joins the Aras River. The protocol, signed by both countries in 1954, contains provisions on the establishment of joint gauging stations and on the principles concerning the storage and diversions of water.

(e)Proposed protocol with Syria on the Çağçağ Stream

37. This stream also emerges in Turkey. It enters Syria where it joins the Khabour which is a tributary of the Euphrates River. A joint protocol was drafted

with syria on 13 May 1952 in connection with the planning work by Turkey on an irrigation project covering 12.000 hectares.

38. The main items covered by this draft protocol consist of:

(1) Division of the waters of the Çağçağ Stream in equal amounts by the two countries,
(11) In case one of the countries involved is not prepared to utilize her share of water she will allow the other country to utilize that share,
(111) Both countries shall make studies on the conservation of water of this stream and on the possibilities of constructing a dam for storing winter flows.
(1V) It was recommended to hold joint discussions on the Asi (Orontes) and Afrin Rivers which flow into territories of both countries.

39. In the meeting which was held for preparing this draft protocol, the Turkish Delegation uphold the view that this draft protocol should become effective when an agreement is reached on the Asi and Afrin Rivers.

(f) Proposed protocol with Syria on the Asi (Orontes) River

40. The Asi River originates in Syria and forms the common boundary between Turkey and Syria before it enters Turkey where it flows in the southern part of the Amik Plain and reaches the Mediterranean Sea near the Samandağ Mountain.

41. Syria has engaged the services of NEDECO, a Dutch firm which prepared a plan providing for the development of this river where consideration was given to the projects in Syria, without mentioning the requirements, interests, and acquired rights of Turkey, and where some solutions were presented which were considered to be against the interests of Turkey.

42. During a conference held between the engineers from both countries the Turkish Delegation proposed the adoption of a draft protocol containing the following main items on the actions tobe taken in collaboration :

(1) Preparation of a development plan for the Asi River which will best serve the interets of the two countries and assist in their development,
(11) Determination of the necessary flood control measures,
(111) Review and revision of the NEDECO Plan by giving due consideration to the above items (1) and (11)
(1V) Determination of the feasibility of constructing a dam at the border for meeting the irrigation water requirements in the Amik Plan,
(V) Establishment of joint stream gauging and flood warning stations.

43. However the conference ended without reaching an agreement on such a protocol.

E. DEVELOPMENT POSSIBILITIES ON SOME INTERNATIONAL RIVERS

(a) The Euphrates River

44. It is well known that all the sources of this major river of historical record are in the territory of Turkey. After leaving Turkey it flows through Syria and Iraq, and joining with the Tigris River, they reach the Persian Gulf together. The following figures may serve to illustrate the general characteristics prevailing in the three sections along the course of the Euphrates belonging to the three countries:

	Turkey	Syria	Iraq
Annual Discharges (10^9 m^3)	23	24	29
Irrigable Areas (10^6 hectares)	8	0,7	1.36
Irrigation Requirements (10^9 m^3)	12	7.6	17
Power Potential (10^9 kwh)	17	-	-

45. Because the Euphrates River is literally of vital importance for the three countries through which it flows, it is absolutely necessary that these countries should work in cooperation in the development of this river. In view of the important economic factors involved in this development such a cooperation is the only rational way which is well supported by the teachings of science and technology. Another consideration of almost equal importance is the well established technical fact that planning and constructing dams and power plants by each neighbour in her territory when there is no comprehensive development plan covering the whole basin of a river is a situation whicl is bound to be uneconomical, and involve even the construction of some structures which are actually unnecessary.

46. In the case of the Euphrates River, studies for such a development plan will undoubtedly show that, due to the existing geographic and topographic conditions, the best solution would be reached by meeting the power requirements of the three countries by constructing one, or possibly two, dams with accompanying power plants up the river in Turkish territory. Such a solution would provide a reduction of up to 60 % in the costs which would have to be borne by the other countries. This solution, which is well supported by scientific and technological facts, is attainable by reaching an agreement in a joint conference among the three countries.

(b) The Meriç (Evros) River

47. The Meriç River emerges in Bulgaria and on its course it forms the common boundary between Turkey and Greece. In view of the first principle of modern planning which consists of taking into consideration all the resources and requirements existing in a river basin as a whole, work on this river should also be undertaken according to an agreement among the three countries.

48. It is believed that by holding the flood waves behind dams in the upper parts of the river the cost of the flood control works needed by the three countries could be reduced considerably, and would become more dependable, the drainage problems would be simpler, and storage of irrigation water would become possible. This arrangement would also be useful in the planning of power production and, possibly, in inland navigation by larger vessels.

49. Although it may be rather late by now, it is nevertheless worth while from the point of view of future development work on this river to recommend strongly that an agreement should be made among the three countries.

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NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

A LOW COST DEVICE TO MAKE BIG RIVER CLOSURES

Performance at the Paulo Afonso power project on the São Francisco River

A 3.2.3 Octávio Marcondes Ferraz, Consulting Engineer.
Brazil

1. LOCATION - Across the São Francisco river at the Paulo Afonso falls was built a mixed type (wall and gates) dam, 4,300 meters long, crossing several natural channels. During the dry season one of these channels, the main one, carries the entire volume of water, that is, 1,300 m^3/sec. At the site chosen for the dam, the river bed is 120 meters wide and has an average depth of 7 meters, with sections reaching even 14-15 meters. The velocity of the water at the section of greatest flow varies between 3.5 to 4.5 m/sec. After damming the first half of the river, we ran up against current speeds reaching up to 8.5m / sec. in the second half. Due to the above conditions the river bed had to be of solid rock. The river bed is covered with an overburden of large and small boulders mixed with sand and mud, fitting the blocks together.

2. PROBLEM - The first half of the dam was built away from the main channel, without greater problems. Then, due to the above mentioned circumstances, a serious problem arose in the main channel. In view of the importance and the time necessary for the works, the same would be submitted to the worst natural, local conditions, with great changes in discharge with consequent changes in water levels, it was decided, to divert the current, to use the cellular type of cofferdam in steel sheeting piles. This type of cofferdam will resist, as it really did, the great floods of the São Francisco river. The problem, however, was the erection of the cells, due to the depth, irregularities of the bed and specially the velocity of the stream. If we admit a water speed of 4.5 mt/sec., according to DEBUAT's formula, the impact on the cell would be of 300 metric tons. Therefore, we had to build a dam across a river 120 m wide, uneven and rocky bottom, with a minimum discharge volume of 1,300 m^3/sec. and a current velocity varying, according to the circumstances, from 3.5 to 8.5 mt/sec., and a variation of depth ranging from 7 to 14 meters.

3. POSSIBLE SOLUTIONS

a) The most natural way out of the problem would be to build a canal by-passing the working area, thus, diverting the current. But such a canal would have to be cut into the solid rock, be 350 meters long and deep enough to carry easily the water stream, which would mean excavating approximately 300,000 m^3 in volume, that is, more than the amount required for the total excavation for the foundation of the 4,300 m long dam. Two temporary rock-fills, should, the upper one, divert the main stream into the canal, and the lower one, complete the closing and drying of the working area forming the cofferdam.

b) The "crib" solution was also studied, but the "Crib cofferdam", for a positive construction, needs a very detailed knowledge of the river bed profile,

and this was not possible in this particular case due to the local conditions. Neither the sounding nor the echo-bathymetry gave good results in the site. Furthermore, the lumber at the site, in the size and type required, was very costly and therefore very antieconomical.

c) The third solution, which was eventually adopted, consisted of the use of the steel sheeting-piles cells capable, better than any other, to resist the floods that sometimes attain 20,000 m^3/sec. in volume, but normally 10,000 m^3/sec. It had also the advantage of adapting itself well enough to the roughness of the river bed, as will be shown later on, and the possibility to be erected on the site and in a short time, at a reduced cost. Nevertheless, it was possible to complete the erection, only by using two original devices, the description of which is the real purpose of this paper.

4. MODEL - These ideas or tricks were the following: - During the first stage (first half - left bank) a floating caisson was used, generally referred to as "navio" (means "ship" in portuguese) that permitted the erection of the cells in still waters; during the second stage (second half - right bank) a device called "flexible structures" duly rock-filled was used to still the water and allowed the erection of the remaining cells in all safety. Therefore, this operation was of great responsibility not only because it was the key problem of the job, but also because it involved very high expenses. We called upon the scale model laboratory that was located on the site to solve all hydraulics problems that would arise. A glass canal was built, where the discharges, pressures, velocities and even the strains on the structures were measured and controlled. The model of the "navio", its performance, effects, etc., everything was carefully studied with a 40:1 model (linear scale $\lambda = 40$). The similarity laws gave the following ratios: $\sqrt{\lambda}$, $\lambda^{5/2}$, λ^3 respectively for the velocities, discharges and strains. It determined two very important data: the impact strain on the "navio" and the water level raise, once the rock-fill was completed. Figures II, III, IV and V refer to the scale models.

5. EXECUTION - The actual construction work was done in two stages: First, the construction of the threshold and pillars on the left bank. Second, the construction of the works on the right bank.

a) First step - To allow for the erection of the cells, a scale model of a floating "caisson" called "navio" was studied as described above. Firmly anchored, with cables at a point 100 m up stream, the prototype could move so as to be placed in front of the cell to be erected. Once in position, the "navio" was sunk by opening the valves and there it served as a shield, protecting and allowing the erection of the cell. This would have been impossible without this original device, due to the high velocity of the water and its depth. The dislocation of the "navio" was done, transversely, with the help of adequate hoists; and longitudinally with great winches. Once completed the erection of the cell, behind the shield formed by the "navio", it was floated, dislocated and sunk again on the site where the next cell was to be erected. We will not describe here the ways used to erect and launch the "navio". The "navio" was locally built with profiles and steel sheets and weighed roughly 125 tons. Its physical dimensions were: 18 m long, 10 m high and 6 m at its maximum width. A heavy ballast on its bottom held it in the correct position. With such dimensions it allowed for the erection of 7 cells and 1 cell, with diameters of 15.20m and 17.50m, respectively. The layout adopted was the one shown on figure I. The cofferdam was closed at the bank side by a platform-wall built in stone masonry and shaped as a box filled with waste. We will skip, without insisting, over problems regarding infiltration, roughness of the river bed and reduced working space inside the cofferdam. As the cells were erected on the "overburden" the infiltrations were important and the work of excavation, cleaning and concreting was quite hard, but it was executed correctly and in

safety. In fact, the erection work of the cells and of the excavations was accomplished without any serious personal injuries and also without any incidents worth mentioning, in spite of the extremely hard kind of work. During the flood season the work had, evidently, to be suspended, but it did not affect the device. Once the flood wave receded, the pumps emptied the cofferdam and the work was resumed. The cellular system, as expected, functioned perfectly well. Figure III shows the use of the "navio" during the erection of cell no. 4. Once the threshold, pillars and gates were built, we dismantled cells (fig. I) 1, 2, 3, 7 and 8. Then the gates were opened and the river discharge passed on both sides of the "isle" formed by cells 4, 5 and 6, which served then as a working platform. At this point, the works for the second step of the closure were started. It should be noted that all the material from the disassembled "navio" was recuperated and used elsewhere in the works.

b) Second step - As we started to close the river in order to build the second half of the dam (threshold and pillars) right over the thalweg of the river, its flow measured 1,300 m³/sec. It was necessary to erect cells 9, 10 and 11, in order to control the river, and this required the tranquilization of its very rapid flow. Cell no. 12 functioned only as an auxiliary platform. We thought at first of using the "navio" method for this second step, but it was noted that when the last cell was placed the velocity attained 11 m/sec., which would make the anchorage of the "navio" an extremely difficult job. So, it was suggested the adoption of the "obelisk" process, used to close the Saguenay, in Chute Caron, Canada. It consists in building a heavy vertical dam (around 2,500 tons) which has to adapt itself exactly to the irregularities of the river's bottom and has to be thrown suddenly over the river. For this method, two conditions are essential: a solid and large base and the accurate knowledge of the river bed, but both could not be attained. Besides its high cost, the obelisk, when falling, would destroy the "island" which, as has been stated, was formed by cells no. 4, 5 and 6, absolutely necessary for the construction. We then thought about using one or two steel structures, light and flexible, attached to a net and riprapped with man-stones (figure VII). Such structures would be made of frames containing necessary devices in order to be well adapted to the irregularities of the river bed. All this framework would be placed downstream the cells to be erected and would be easily removed after being used. This system was tested on a small scale and proved to be economical, safe, quickly made and efficient. The performance of the model and the prototype were in perfect accordance (see figures X and XI). The two structures consisted of a certain number of trestles forming a very light framework (looking like a cage), whose upright pieces were built with angles welded so as to form a square pipe, and joined together by angles. To this framework we fixed a steel net with 0.20m x 0.20 mesh. The weight of each structure was about 20 tons, so they could be easily moved by the local existing cranes, an important point for the speed of the work. Once in place, the structures were filled with man-stones, as shown in figure VIII. The stones were placed in horizontal layers so as not to create wakes of great speed of water, which is a precaution one has to take in such operations. The height of these flexible structures was 10.5 m and the total gap to be closed was about 44 m. The base of the trestles was 5 m wide. The structure was tied up with 1" steel cables so that it would not be carried down by the water current before the rock-filling operation. As the riprap progressed, the water level increased and its flow was diverted through by-passes constituted by pillars and gates built in the first step. An idea of the placing of the structures and of the rock-filling is given by figure IX. Once the riprap was completed with man-stones weighing 25 to 35 kilos, the flow of water got smooth in the second-half of the river, since the velocity of water corresponded only to the leaking through the stones, which was really very little. The total placing of the steel structures was made in 8 calendar days and the riprap in 9 days. The material used was 40 tons of 3" and 4" angle iron, approximately 6 tons of 1/2" round iron; 1" and 3/4" steel cables, plus 6,000 m³

of man size stone. 25,000 man/hrs were spent for the complete job of setting the structures and the rock-fillings. As this device was located downstream the closing cells, all the material was recuperated, including the stone. It should be mentioned that the entire operations ran according to plans without any disagreeable surprise.

6. COST - Finally, we wish to say a few words on the subject of the cost of the operation. It amounted to US$42,000, including angle irons, nets, labor, stone, hauling charges, miscellaneous, overall expenses, equipments and administration. In these figures the value of the material recuperated was not deducted from the total value. To have a better idea of the smallness of this cost, it is sufficient to say that the cost for closing a gap of 120 m (three times the project described above) on the Columbia river was, according to reports, US$ 1,318,000.

The design and work of the river closure were made, under our direction, by the technical staff of Cia. Hidro Elétrica do São Francisco, owner of the power-plant, in June-July, 1954.

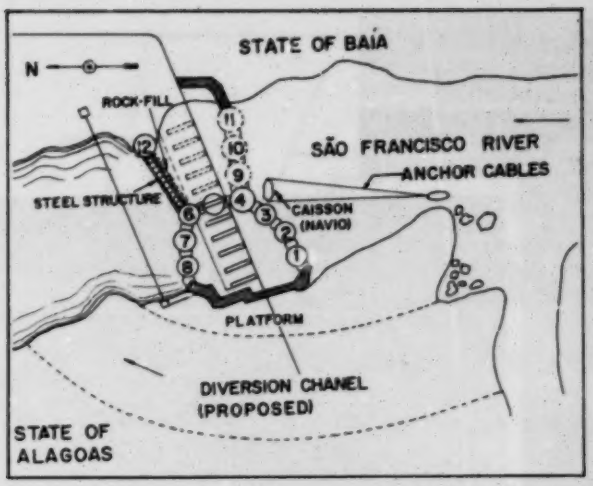

Fig. I - General layout

Fig. 3 - Performance of the "navio" (model)

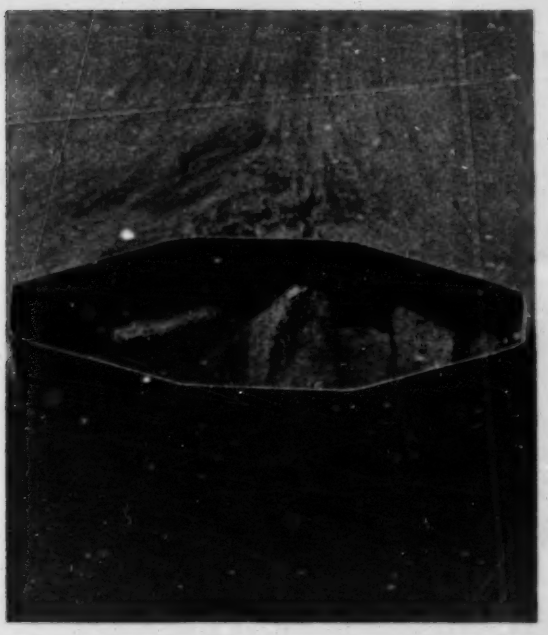

Fig. 2 - Impact on the caisson ("navio") (model)

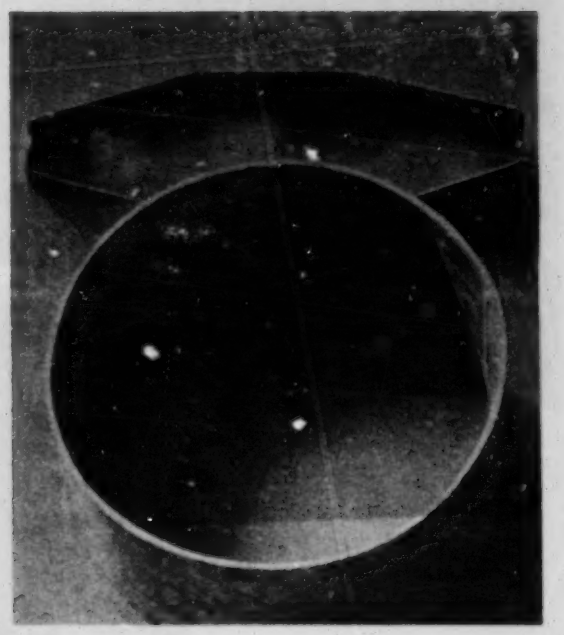

Fig. 4 - The "navio" protecting a cell (model)

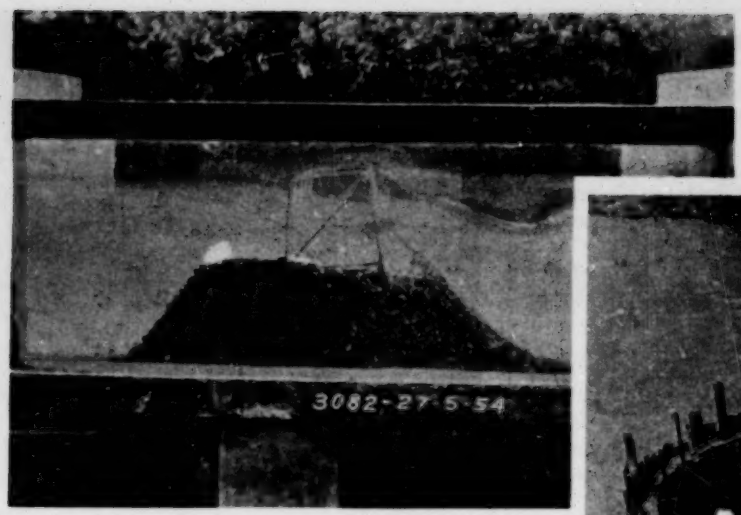

Fig. 5 - Steel-structure and rock-fill (model)

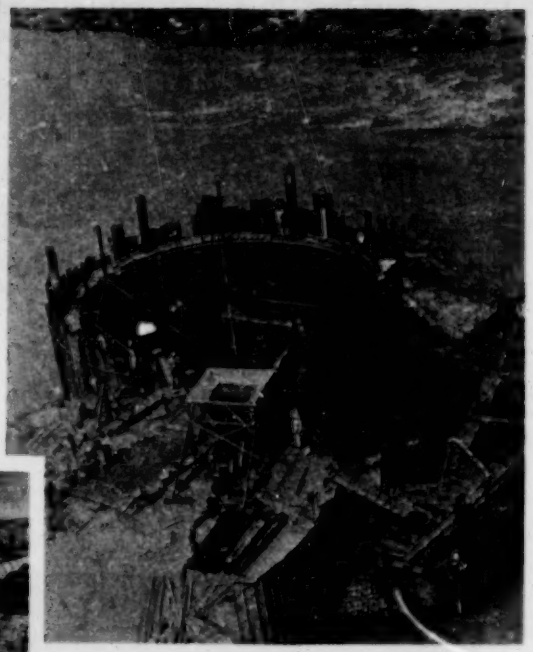

Fig. 6 - Cell no. 4 protected by the "navio" (prototype)

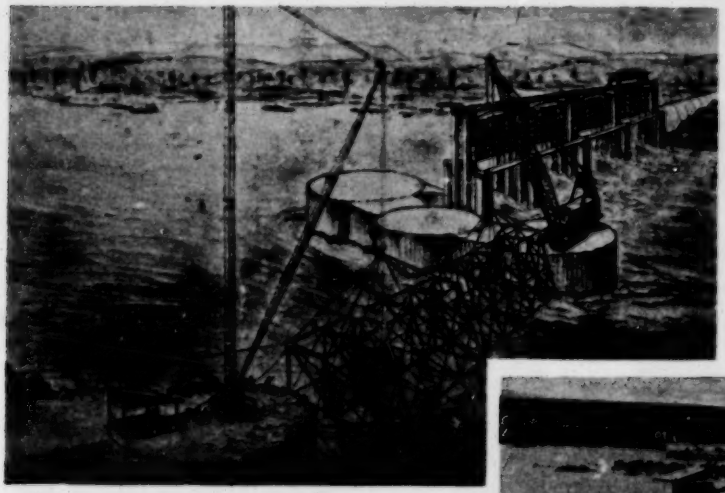

Fig. 7 - "Island" and the structures setting

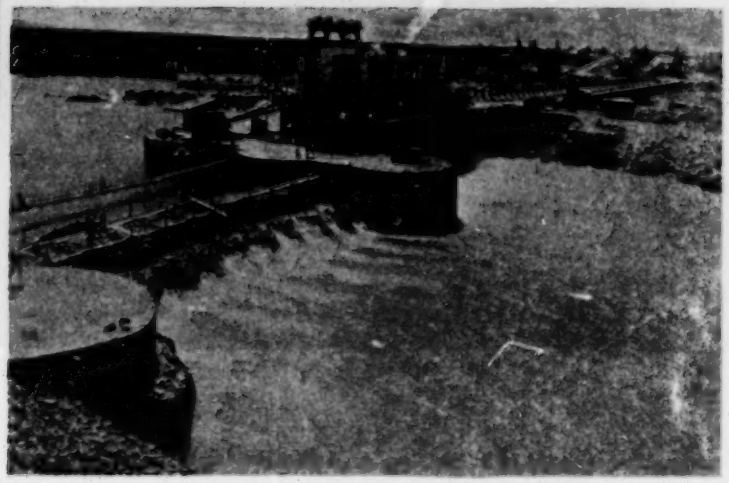

Fig. 8 - Seepage through the rock-fill

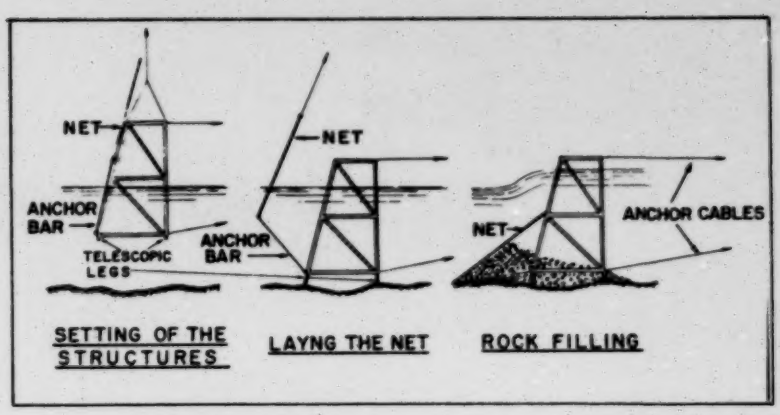

Fig. 9 - Steps of the structures setting

Fig.10 - Rock-fill (model)

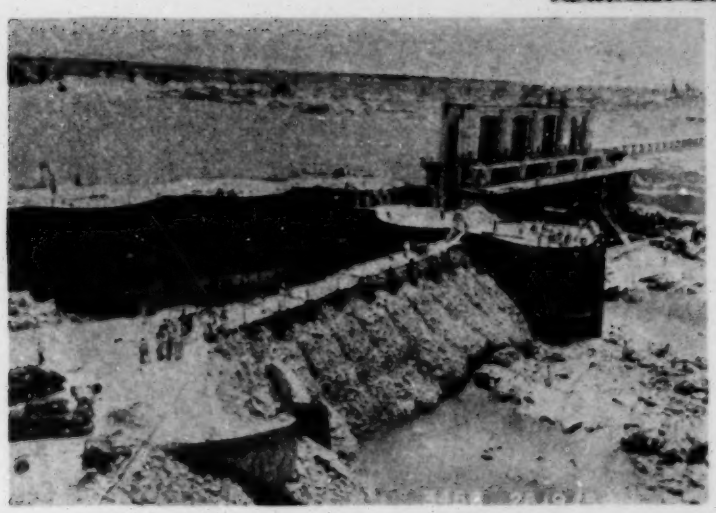

Fig.11 - Rock-fill (prototype)

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ПРИМЕЧАНИЯ

1. Документы, включенные в число материалов, принятых для обсуждения на общих сессиях, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

2. Документы, включенные в число материалов, принятых для обсуждения на специализированных сессиях, будут в распоряжении делегатов Конференции только на одном из этих официальных языков.

3. Резюме всех документов в том виде, в каком они были представлены их составителями, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

4. До открытия Конференции документы и резюме не будут выпущены для общего распространения. Они будут опубликованы заблаговременно только в ограниченном числе экземпляров и исключительно для правительственных делегаций и других правомочных участников. Последующие опубликование и рассылка трудов Конференции будут обеспечены в соответствии с практикой Организации Объединенных Наций, как это установлено ее Издательским комитетом.

КАРТОГРАФИРОВАНИЕ ПРИРОДНЫХ РЕСУРСОВ ПРИ СОЗДАНИИ НАЦИОНАЛЬНЫХ И РЕГИОНАЛЬНЫХ КОМПЛЕКСНЫХ ГЕОГРАФИЧЕСКИХ АТЛАСОВ.

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Международного Географического Союза.

Решение любых экономических задач, связанных с использованием территории и эксплуатации природных богатств требует постановки и осуществления больших картографических работ по созданию топографических и различных специальных /например, геологических, почвенных и т.п./ карт. Но после 2-й мировой войны в ряде стран стало также проявляться весьма энергичное развитие комплексного /то-есть многостороннего и взаимосвязанного/ картографирования, образующего теперь стержень географической картографии и один из основных путей практического приложения и использования достижений географической науки. В этом деле очень велико значение комплексных географических атласов, состоящих из разных по содержанию карт, не дающих в совокупности полную характеристику целостной группы явлений /например, природных условий и ресурсов/ с их взаимосвязями и обусловленностями.

Комплексные атласы, обобщающие результаты многосторонного изучения природных условий, ресурсов и производительных сил, представляют результаты этих исследований в форме наиболее удобной для обзора, анализа и обработки, позволяющей характеризовать явления мерою и числом и потому особенно ценной для практики.

XVIII Международный Географический Конгресс, собравшийся в 1956 г.в Рио де Жанейро, отнес к числу центральных задач географии создание национальных атласов, то-есть капитальных комплексных географических атласов отдельных стран, содержащих свод и обобщение современных научных знаний по физической, экономической и политической географии данной страны, всесторонне отображающих её жизнь и необходимых для улучшения этой жизни.

Тогда же в помощь этому делу IX Генеральная Ассамблея Географического Союза учредила Комиссию национальных атласов, призванную содействовать созданию и повышению качества национальных атласов, в частности посредством международного сотрудничества в обобщении накопленного опыта, в обмене этим опытом и в его распространении.

Обсуждение национальных атласов на следующем XIX Международном Географическом Конгрессе в 1960 г.в Стокгольме показало

существенный прогресс в их развитии. К этому времени двенадцать стран, занимающих почти третью часть всей суши, уже имели национальные атласы; в десяти странах велась публикация атласов, а двенадцать стран приступили к их изготовлению. Особо отмечалась успешная работа над национальными атласами в Индии /где для этого учреждена специальная Организация национального атласа/ и в Марокко-государствах сравнительно недавно вставших на путь самостоятельного политического и экономического развития, опыт которых очень интересен для стран, вновь обретших свою независимость.

Комиссия национальных атласов представила Конгрессу свое исследование "Национальные атласы - история, анализ, пути совершенствования и унификации", в котором подытоживался предшествующий опыт по созданию национальных атласов, формулировались предъявляемые к ним требования, обосновывались структура и основные разделы национальных атласов и в частности были включены рекомендации по тематика и содержанию карт природных условий и естественных богатств.

На четырехлетие 1960-1964 г.г. Комиссия национальных атласов расширила круг своих интересов и поставила в качестве дополнительных задач: а/ исследования по комплексным региональным атласам; б/ изучение требований жизни и разработку путей возможно более эффективного применения комплексных атласов для удовлетворения потребностей практики; в/ унификацию программ и легенд основных карт национальных атласов /с целью облегчить создание таких карт и совместное использование карт разных атласов в международных научных и практических мероприятиях.

В решении этих задач по плану и в связи с деятельностью Комиссии национальных атласов принимают участие научные учреждения и ученые ряда стран. В частности, в 1964 г. на XIX Международном Географическом Конгрессе в Лондоне должны быть рассмотрены предложения по унификации легенд и содержания некоторых карт природных ресурсов. Например, в СССР согласились работать и представить такие предложения по почвенным картам Почвенный Институт им. Докучаева в Москве, по картам растительности Институт Географии Сибири и Дальнего Востока и т.д.

Следует особо остановиться на исследованиях в области региональных атласов. Во-первых, усиление работы над ними составляет важную черту в современном развитии комплексного картографирования /над ними энергично трудятся в настоящее время в Австрии, Канаде, СССР, США, Франции и ФРГ/, во-вторых, ряд из этих атласов специально предназначается в помощь решению проблемы изучения, развития и рационального использования природных ресурсов.

В настоящее время региональные атласы готовятся главным образом в экономически развитых странах, но они должны быть особенно полезны для удовлетворения потребностей менее развитых районов. 3-я Картографическая региональная конференция Объединенных наций для стран Азии и Дальнего Востока, собиравшаяся в Бангкоке в ноябре 1961 г. одобрила и внесла в свои решения предложение о начале работ по созданию и публикации региональных атласов для Азии и Дальнего Востока. Важно содействовать развитию и правильному направлению этих работ.

Существующие региональные атласы разнообразны по своим целевым установкам и содержанию. Большие австрийские атласы /провинций Верхняя Австрия с 1958 г., Нижняя Австрия 1951-1958 г., Зальц-

бург 1955 г./ имеют научно-познавательный, краеведческий характер с большим упором на историко-этнографическую тематику. Атласы ФРГ, хотя и предназначены служить пособием для управления, планирования и устройстве территории отдельных земель, но в условиях развитой промышленности и интенсивного сельского хозяйства сосредотачивает главное внимание на картах экономики и населения. Еще сильнее эта черта проявляется во французских региональных атласах Севера /1961 г./ и Востока Франции /с 1958 г./, дающих изолированный анализ экономических явлений без учета всего комплекса географических условий, в том числе природных ресурсов. Атлас Иллинойса /с 1958 г./, одного из наиболее развитых штатов США, имеющий основной целью показать деловым людям преимущества штата для дальнейших капиталовложений, содержит практически целеустремленный обзор экономических, в том числе природных ресурсов штата, но рассматривает их главным образом с точки зрения интересов промышленности.

По нашему мнению для комплексного картографирования природных ресурсов менее развитых районов /как необходимой предпосылки для развития этих ресурсов/ наиболее подходит опыт Канады и СССР. Канадский атлас ресурсов Британской Колумбии /1956 г./четвертую часть своих карт уделяет освещению природных условий и, плюс к тому, почти половину объёма предоставляет картам использования ресурсов. Его основная цель дать возможно более полный обзор природных ресурсов, полезный при разработке и осуществлении планов их охраны, развития и рационального использования, а также для ознакомления граждан с её естественными богатствами. Например, один из листов атласа дает ясное представление о гидроресурсах, какими располагает провинция, о существующих электростанциях, о запасах и объёме использования гидроэнергии, о намечаемых к строительству плотинах и т.д. Таков же примерно другой канадский региональный атлас для провинции Манитоба /1960 г./

В Советском Союзе, где такие задачи, как всестороннее и рациональное использование естественных богатств, их восстановление и умножение, целенаправленное преобразование природы, рациональное плановое размещение промышленности и сельского хозяйства, комплексное развитие крупных экономических районов и др., требуют конкретного знания природных условий и ресурсов, разделам физико-географических карт уделяется в региональных атласах еще большее внимание. Например, карты природных условий и ресурсов занимают около половины объема Атласа Армянской ССР /1961 г./

В лучших советских региональных атласах каждому из элементов природной среды обычно посвящается особая коллекция карт, заслуживающих внимания и по своей полноте, и по внутренней согласованности. Это не просто набор отдельных карт природы, а их целостная система, прекрасное средство для анализа взаимосвязей и зависимости явлений.

В работе над современными региональными атласами проявляется одна интересная черта. Они попрежнему создаются в результате коллективной работы, возглавляемой крупными, авторитетными географами, но средства на их изготовление и публикацию всё чаще предоставляются органами местной власти, что свидетельствует о возрастающем практическом значении этих географических трудов.

Изготовление многих региональных атласов основано главным образом на мобилизации и обработке материалов уже произведенных исследований и в таком случае не связано с полевым картографированием, хотя и может нуждаться в сборе имеющихся материалов на ме-

стах, например, в научных учреждениях, административных центрах и т.п. При таком методе создания атласов, предназначенных для инвентаризации природных ресурсов, как бы инвентаризируются и сами знания, накопленные о природных условиях и ресурсах и наглядно выявляются остающиеся в этих знаниях пробелы.

Однако в ряде случаев создание комплексных региональных атласов связано с проведением специальных исследований не только для мобилизации уже имеющихся данных, но главным образом для восполнения пробелов в источниках и даже проведения полного сбора данных /картографирования/ по некоторым темам атласа. В частности, такой метод был использован при создании некоторых региональных атласов СССР на менее развитые в прошлом районы, подвергшиеся затем интенсивному хозяйственному освоению. Опыт этих работ освещен в научной литературе.x/ Их суть - комплексные географические исследования.

Картографирование природных условий и естественных богатств менее развитых районов является важной предпосылкой для подъёма их экономики, но связано с серьезными трудностями - еще недостаточной разработанностью методических вопросов картографирования природных ресурсов и слабым состоянием и неравномерностью их изученности.

Содействие решению методических вопросов создания региональных атласов - одна из новых целей деятельности Комиссии национальных атласов Международного Географического Союза. Ее конкретные задачи в этой области: регулярное оповещение о выполняемых атласах, анализ опубликованных атласов, содействие обмену опытом, изучение запросов потребителей и особенностей конкретного использования в научных исследованиях и практической деятельности и, в меру возможности, разработка на этой основе рекомендаций, касающихся тематики, содержания и показателей основных карт региональных атласов. В частности, намечается опубликовать к XX Международному Географическому Конгрессу 1964 г. сводный обзор региональных атласов, их истории и современного состояния.

Конечно, эта помощь делу создания региональных атласов не может считаться ни исчерпывающей, ни достаточной. Значение проблемы картографирования природных ресурсов менее развитых районов таково, что к ней должно быть привлечено внимание и широкой международной общественности, и соответствующих учреждений Организации Объединенных Наций.

Экономический и Социальный Совет ООН, который уже организовал и провел посредством Отдела картографии Департамента экономических и социальных дел три региональных картографических конференции Объединенных Наций для стран Азии и Дальнего Востока и в 1962г. Международную техническую конференцию Объединенных Наций по Международной карте мира в миллионном масштабе должен, по нашему мнению, включить в круг своих картографических интересов картографирование природных ресурсов посредством создания национальных и региональных комплексных географических атласов и подготовить широкое международное распространение этой проблемы, как в методическом плане, так и в плане материальной помощи картографированию менее развитых районов.

x/ "Комплексные атласы республик, краев и областей", под редакцией А.Н.Баранова и К.А. Салищева. Геодезиздат. М.1961 г.

600 R - Oct.1962 - 600

E/CONF.39/A/157/Corr.1
14 Jan.1963
ORIGINAL : RUSSIAN

КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
ПО ВОПРОСУ О ПРИМЕНЕНИИ НАУЧНЫХ И ТЕХНИЧЕСКИХ ЗНАНИЙ
ДЛЯ УДОВЛЕТВОРЕНИЯ ПОТРЕБНОСТЕЙ МЕНЕЕ РАЗВИТЫХ РАЙОНОВ

И С П Р А В Л Е Н И Е

Вместо : пункт повестки дня : A.I.
надо читать : A.I.I.

600 R - Jan.1963 - 600

E/CONF.39/A/158
23 Oct.1962
ORIGINAL : RUSSIAN

КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
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ПУНКТ ПОВЕСТКИ ДНЯ: A.5.2.1

СССР

ГЕОФИЗИЧЕСКИЕ МЕТОДЫ РАЗВЕДКИ НЕФТИ И ГАЗА В МЕНЕЕ ИССЛЕДОВАННЫХ РАЙОНАХ

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Документы, составленные для Конференции Организации Объединенных Наций по вопросу о применении научных и технических знаний для удовлетворения потребностей менее развитых районов, служат в качестве рабочих документов для этой Конференции. Они опубликованы в том виде, в каком были представлены их составителями, и их содержимое и выраженные в них мнения принадлежат их составителям (см. примечания на оборотной стороне).

ПРИМЕЧАНИЯ

1. Документы, включенные в число материалов, принятых для обсуждения на общих сессиях, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

2. Документы, включенные в число материалов, принятых для обсуждения на специализированных сессиях, будут в распоряжении делегатов Конференции только на одном из этих официальных языков.

3. Резюме всех документов в том виде, в каком они были представлены их составителями, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

4. До открытия Конференции документы и резюме не будут выпущены для общего распространения. Они будут опубликованы заблаговременно только в ограниченном числе экземпляров и исключительно для правительственных делегаций и других правомочных участников. Последующие опубликование и рассылка трудов Конференции будут обеспечены в соответствии с практикой Организации Объединенных Наций, как это установлено ее Издательским комитетом.

ГЕОФИЗИЧЕСКИЕ МЕТОДЫ РАЗВЕДКИ НЕФТИ И ГАЗА В МЕНЕЕ ИССЛЕДОВАННЫХ РАЙОНАХ.

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Организация, последовательность и объемы разведочных работ на нефть и газ зависят от степени геолого-геофизической изученности интересующей территории. При слабой изученности глубинных недр проведение нефтепоисковых работ, как показывает обширная практика, геологоразведочных работ в СССР, следует начинать с региональных геофизических исследований территории, с изучения общих черт ее геологического строения. Только после того, как будет в региональном плане изучено геологическое строение территории и выявлены основные закономерности простирания и расположения возможных ловушек нефти и газа целесообразно приступать к детальным работам по поискам нефтяных и газовых месторождений.

Такая организация и последовательность работ дает возможность при минимальных затратах в наиболее короткие сроки с необходимой детальностью изучить геологическое строение территории, оценить перспективы ее нефтегазоносности и, наконец, открыть месторождения нефти и газа.

В числе региональных геофизических работ целесообразно проводить аэромагнитную и гравиметрические съемки в масштабах от I:I.000.000 до I.200.000 /в зависимости от размеров территории/, выборочно съемку методом теллургических токов масштаба I:200.000 и выборочно же сейсмическое профилирование чаще всего корреляционным методом преломленных волн для картирования поверхности кристаллического фундамента.

В начальный период осуществления магнитных съемок территории СССР казалось, что данные этих съемок могут быть использованы только для изучения петрографических неоднородностей фундамента и для расчленения фундамента обширных территорий страны по петрографическим особенностям.

Первое наиболее крупное обобщение результатов магнитных съемок по территории Европейской части СССР, осуществленное под руководством А.Д. Архангельского /а/ показало, что линейные группы магнитных аномалий определенным образом связаны с тектоническим строением изучаемой территории. С тех пор накоплен обширный фактический материал, показывающий, что данные региональных магнитных съемок дают возможность наметить основные направления зон глубинных разломов, отображающихся на магнитных картах системой полос магнитных аномалий.

Сопоставление линейных зон магнитных аномалий с основными элементами тектоники осадочного чехла показывает на существование во многих случаях определенных четких связей между направлениями осей магнитных аномалий и направлением основных тектонических линий осадочного покрова. Обусловлено это повидимому

унаследованностью во многих случаях более поздних тектонических движений от более ранних, вызвавших прорывание основных и ультраосновных магнитных пород по зонам дробления и разломам в гранитную толщу земной коры или образовавших на древней поверхности земли мощные эффузивные тела, обладающие повышенной намагниченностью. Поздние движения захватили образовавшуюся к тому времени осадочную толщу и, таким образом, более поздняя тектоника верхних частей земной коры оказывается согласующейся с направлением древних зон разломов в кристаллическом основании.

Региональные гравиметрические съемки мало изученной территории дают возможность тектонического районирования территории. На гравиметрических картах четко выделяются зоны прогибания фундамента, выполненные мощными толщами осадочных отложений, намечаются крупные положительные структуры типа валов и сводовых поднятий, выявляются зоны крупных разломов в фундаменте, вдоль которых произошли сильные передвижки пород фундамента и осадочного чехла. В тех случаях когда в зоне депрессии развита соленая тектоника по гравиметрическим данным определяется местоположение соляных куполов.

В сопоставлении с картами магнитных аномалий однозначно определяется положение зон глубинных разломов, являющихся активными тектоническими участками земной коры.

Совокупность гравиметрических и магнитных данных для малоизученной территории в комплексе с имеющимися геологическими данными исследуемой территории и наметить участки для постановки детальных геофизических и буровых нефтепоисковых работ. В качестве примеров использования магнитных и гравиметрических данных для изучения глубинного геологического строения слабо изученных территории можно указать работы /в/, /с/, / /.

Использование метода теллурических токов открывает широкие возможности для картирования поверхностей электрически непроводящего фундамента. Такие поверхности в зависимости от геологических условий могут быть образованы: 1/ кристаллическим или метаморфизованным фундаментом, 2/ карбонатными отложениями, 3/ гипсово-ангидритовыми образованиями.

Систематическое площадное картирование поверхности непроводящего фундамента методом теллургических токов позволяет составить структурную карту выбранного масштаба по указанной поверхности и на этой карте выделить интересующие нефтяных геологов приподнятые зоны, которые могут быть объектами детальной сейсмической и буровой разведки.

Подробности о теории и методике разведки с использованием теллургических токов приведены в книге /е/.

Точность и достоверность геологических построений значительно повышается с привлечением в комплекс региональных исследований слабоизученной территории сейсмического метода.

Сейсмические исследования корреляционным методом преломленных волн, проведенные на редкой сети профилей вкрест простиранию основных тектонических линий, намеченных по гравиметрическим и магнитным данным, позволяют оценить с достаточной степенью точности глубины залегания кристаллического фундамента и соответственно мощность осадочного чехла, определить природу гравитационных и магнитных аномалий и существенно уточнить структурно-тектонические построения, сделанные по другим геофизическим

и геологическим данным. Поучительный опыт региональных сейсмических и комплексных геофизических исследований глубоких недр земли можно почерпнуть из статей Ю.Н.Година / /, /д/.

После проведенных региональных геофизических исследований слабо изученной территории или одновременно с ними выполняются детальные геофизические работы по поискам ловушек нефти и газа структурного или литологического типа и по подготовке уже выявленных структур под глубокую буровую разведку.

На территории, глубинное геологическое строение которой в той или иной мере изучено до проведения указанных выше региональных геофизических работ и оценены перспективы возможного нахождения нефтяных и газовых месторождений, обычно сразу проводятся детальные геологосъемочные буровые сейсмические электроразведочные и гравиметрические работы по поискам и подготовке структур под глубокую буровую разведку с одновременным развертыванием работ регионального характера с целью подготовки фронта работ для детальной разведки.

В зависимости от геологических условий и степени геолого-геофизической изученности территории ставится тот или иной комплекс детальных поисковых геолого-геофизических работ. Обычно в этот комплекс входит для поисков и подготовки структур под глубокую разведку структурно-поисковое бурение облегченными буровыми установками и сейсморазведка методом отраженных волн.

На площади, где выявлена структура и эта структура детально изучена, ставится глубокое разведочное бурение с целью обнаружения нефтяной или газовой залежи. Для выявления нефтяных пластов и горизонтов по разрезу этой скважины чаще всего используются методы скважинной геофизики, а также методы детального изучения керна, шлама и пластовых флюидов.

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465 R - Oct.1962 - 600

E/CONF.39/A/159
23 Oct.1962
ORIGINAL : RUSSIAN

КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
ПО ВОПРОСУ О ПРИМЕНЕНИИ НАУЧНЫХ И ТЕХНИЧЕСКИХ ЗНАНИЙ
ДЛЯ УДОВЛЕТВОРЕНИЯ ПОТРЕБНОСТЕЙ МЕНЕЕ РАЗВИТЫХ РАЙОНОВ

ПУНКТ ПОВЕСТКИ ДНЯ: A.4.3.2

СССР

ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ ЯДЕРНОЙ ЭНЕРГЕТИКИ В МЕНЕЕ РАЗВИТЫХ РАЙОНАХ

Составили Юрий КОРЯКИН, кандидат технических наук и
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Документы, составленные для Конференции Организации Объединенных Наций по вопросу о применении научных и технических знаний для удовлетворения потребностей менее развитых районов, служат в качестве рабочих документов для этой Конференции. Они опубликованы в том виде, в каком были представлены их составителями, и их содержимое и выраженные в них мнения принадлежат их составителям (см. примечания на оборотной стороне).

ПРИМЕЧАНИЯ

1. Документы, включенные в число материалов, принятых для обсуждения на общих сессиях, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

2. Документы, включенные в число материалов, принятых для обсуждения на специализированных сессиях, будут в распоряжении делегатов Конференции только на одном из этих официальных языков.

3. Резюме всех документов в том виде, в каком они были представлены их составителями, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

4. До открытия Конференции документы и резюме не будут выпущены для общего распространения. Они будут опубликованы заблаговременно только в ограниченном числе экземпляров и исключительно для правительственных делегаций и других правомочных участников. Последующие опубликование и рассылка трудов Конференции будут обеспечены в соответствии с практикой Организации Объединенных Наций, как это установлено ее Издательским комитетом.

ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ ЯДЕРНОЙ ЭНЕРГЕТИКИ В МЕНЕЕ РАЗВИТЫХ РАЙОНАХ

Юрий Корякин - кандидат технических наук, Владимир Шмелев - инженер.

1. Хорошо известно, что уровень и темпы развития энергетики в любой стране и, в первую очередь, производства электроэнергии характеризуют и определяют уровень и темпы развития всех остальных отраслей хозяйства страны. Другими словами, имеется прямая связь между производством электроэнергии и величиной национального дохода на душу населения; энергетическое строительство является основным стержнем хозяйственного строительства.

2. Естественно, что ориентация на тот или иной способ получения электроэнергии в данном географическом районе, выяснение вопроса о том, какой источник энергии является наиболее предпочтительным, зависят от конкретных местных условий. Выбор оптимального варианта энергоснабжения данного района определяется в результате анализа ряда конкурирующих факторов, характеризующих различные экономические аспекты строительства электростанции того или иного типа.

3. В настоящее время энергетика, основанная на использовании органического топлива или гидроэнергоресурсов, начинает дополняться ядерной энергетикой, основанной на делении тяжелых ядер. Следует отметить, что, как это будет показано ниже, каждый из вышеупомянутых источников энергии в силу своих качественных особенностей оказывает влияние на размещение и развитие производительных сил страны.

4. Оглядываясь на путь, пройденный ядерной энергетикой за 8 лет ее развития с момента пуска в 1954 г. Первой советской атомной электростанции, путь, полный различных мнений и прогнозов, как оптимистичных, так и пессимистичных относительно ее перспектив, нельзя не видеть, что об"ективно развитие ядерной энергетики во всем мире за этот период шло довольно интенсивно.

5. Если в 1954 году действовала только советская атомная электростанция мощностью всего 5 тыс. квт, то в настоящее время во всем мире действуют 24 атомных электростанции общей мощностью 1,4 млн. квт и строятся 26 атомных электростанций на общую мощность 4,8 млн. квт. Ожидается, что в 1980 году количество атомных энергетических мощностей превысит 100 млн. квт.

6. Кривая роста мощностей атомных электростанций представлена на рис. 1. Обычная энергетика развивалась за последние десятилетия с удвоением мощностей в среднем за каждые 10 лет; в то же время ядерная энергетика за 8 лет своего существования развивалась с темпом удвоения своих мощностей в 1 год, т.е. в 10 раз быстрее.

7. Очевидно, что столь высокий темп роста мощностей ядерной энергетики об"ясняется не только заинтересованностью в ее развитии, но и главным образом существенно меньшим, чем у обычной энергетики абсолютным значением ее мощностей. С их абсолютным увеличением темп прироста, естественно, должен замедляться,что и подтверждается намеченными к вводу мощностями атомных электростанций на период до 1980 г. Так на период с 1962 г. по 1970 г. время удвоения мощностей составляет уже 2 года, а с 1970 по 1980 г. - 4,3 года, т.е. существенно замедляется.

8. Рассматривая кривую роста мощностей ядерной энергетики, можно заметить две характерные закономерности, которые представляют собой две стороны одного и того же процесса: во-первых, единичные мощности реакторов атомных электростанций, вводимых в строй в первые годы развития ядерной энергетики /с 1954 по 1960 г./, сравнительно малы,а, во-вторых, разнообразие типов, используемых ядерных реакторов сравнительно велико. За период с 1954 г. по 1960 г. было введено в строй 15 энергетических реакторов семи различных типов, причем средняя электрическая мощность реакторов за этот период составила 30 Мвт.

9. В то же время за следующие 6 лет /с 1960 по 1966 г./ количество вводимых в строй реакторов составит примерно 60, но уже 10 различных типов, однако 7 из них являются повторениями или модификациями типов периода 1954-1960 годов. Средняя электрическая мощность реактора уже составляет 185 Мвт.

10. Эти данные говорят о том, что ядерная энергетика с начала своего развития, т.е. с 1954 г. до,примерно, 1960 г. переживала период поисков наилучших типов реакторов и доказательства в различных странах возможности инженерного осуществления энергетического использования цепной реакции. Другими словами, этот период является периодом создания небольших экспериментальных прототипов атомных электростанций, которые рассматриваются как основа или инженерно-промышленный "задел" для последующего и уже промышленного использования ядерной энергетики. В настоящее время ядерная энергетика вступила именно в этот период, поскольку опыт первых лет эксплуатации ряда опытных атомных электростанций в различных странах мира показал, что атомные электростанции являются надежными и безопасными источниками электроэнергии.

11. Естественно, что заинтересованность в промышленном использовании ядерной энергетики и масштабы ее применения в любой стране могут быть достаточно большими только в том случае, если экономические показатели атомных электростанций не будут уступать экономическим показателям обычных электростанций и, в первую очередь, тепловых электростанций.

12. Период, который переживает в настоящее время ядерная энергетика, является периодом доказательства возможности экономичного производства "ядерной"электроэнергии. Этот период характеризуется рядом закономерно-

стей и мероприятий, которые в конечном итоге проявляются в неуклонном стремлении обеспечить экономическую рентабельность атомных электростанций.

13. В этом отношении ядерная энергетика имеет ряд несомненных успехов. Они говорят о том, что достижение стоимости электроэнергии и удельных капиталовложений, не уступающих аналогичным показателям обычных, даже наиболее экономичных, тепловых электростанций, дело вполне осуществимое в течение ближайших лет.

14. Если рассматривать с общих позиций экономические показатели построенных атомных электростанций, то они, как правило, оказались в 1,5-2 раза дороже, чем тепловые электростанции аналогичной мощности. Это об"ясняется главным образом несерийностью и нестандартностью оборудования станций, когда естественно велики затраты на освоение выпуска нового оборудования и на проведение обширных экспериментальных исследований и проектных работ. Понятно, что при переходе на серийное изготовление оборудования, с развитием стандартизации типов и проектов атомных электростанций их экономические показатели будут существенно улучшаться.

15. Проводимый в ряде стран технико-экономический анализ состояния, темпов и перспектив усовершенствования различных типов мощных реакторов показывает, что экономическая рентабельность атомных электростанций будет достигнута, примерно, к 1970 году.

16. Следует, конечно, иметь в виду, что постепенно темп улучшения экономических показателей ядерной энергетики замедлится. Однако несомненно, что в течение предвидимого промежутка времени во всяком случае на период до 1980 г. он будет выше, чем у обычной энергетики, имеющей "возраст" более 80 лет. Таким образом имеются все основания утверждать, что уже в следующем десятилетии ядерная энергетика не будет испытывать со стороны экономики ограничений для широкого промышленного использования во многих районах земного шара.

17. Все вышесказанное приводит к выводу, что развитие ядерной энергетики неизбежно и доля ее в общем энергобалансе стран будет неуклонно возрастать.

Рассмотрим теперь некоторые качественные особенности ядерной энергетики.

18. Известно, что крупные тепловые и гидравлические электростанции неизбежно "привязываются" к определенным и вынужденным местам расположения: первые к месторождениям природного топлива /с целью максимального снижения расходов на транспортировку топлива или на сооружение газопроводов или нефтепроводов/, вторые - к местам наиболее удобного гидротехнического строительства. При этом наиболее экономически выгодные места сооружения обычных электростанций нередко не совпадают с местами наиболее целесообразного расположения потребителей энергии /промышленных предприятий и сопутствующих им населенных пунктов/.

19. Атомные электростанции в значительно меньшей степени "привязаны" к определенным местам расположения,

вследствие пренебрежимо малых расходов на транспортировку ядерного горючего. Другими словами, технико-экономические показатели атомных электростанций в значительно меньшей степени зависят от их места расположения. Следовательно, сооружение атомных электростанций может и должно производиться в местах наиболее целесообразного сооружения потребителей электроэнергии, что приводит к уменьшению масштабов электросетевого строительства. Это качество ядерной энергетики является особенно ценным для менее развитых стран, которые, как правило, имеют или могут иметь значительное число относительно небольших потребителей электроэнергии, к тому же расположенных на значительных расстояниях один от другого.

20. Таким образом развитие ядерной энергетики способствует облегчению освоения природных ресурсов в районах, неблагоприятных для обычного энергетического строительства.

21. Следует подчеркнуть, что атомная электростанция, независимо от того, какой тип реактора она использует, представляет собой лишь звено в общем топливном цикле ядерной энергетики. Возникновение и обязательное существование топливного цикла связаны с необходимостью регенерации отработавшего ядерного горючего, содержащего невыгоревшие делящиеся изотопы и плутоний и потому представляющего значительную ценность. Это одно из серьезных отличий ядерной энергетики от обычной тепловой энергетики, в которой топливо сжигается полностью, а отходы - зола, практически не имеют ценности. Примерные схемы двух из многих возможных топливных циклов / на природном и на обогащенном уране/ представлены на рис. II и III. Все звенья этих топливных циклов /кроме атомной электростанции/ являются собственными нуждами ядерной энергетики.

22. Организация топливных циклов является необходимой при широком развитии ядерной энергетики. Следовательно, к стоимости каждого киловатта электрической мощности атомной электростанции прибавляются затраты, связанные со строительством соответствующих предприятий топливного цикла /т.н. смежные капитальные затраты/.

23. Примерно аналогичное положение наблюдается и при строительстве обычных тепловых электростанций, к стоимости установленного киловатта которых прибавляются затраты на создание или расширение транспортных путей подвоза ископаемого топлива.

24. Величина смежных капитальных затрат для обычной энергетики зависит от конкретных условий и района расположения тепловой электростанции. Однако характерным является то, что она довольно велика и составляет от 60 до 100% от стоимости установленного киловатта тепловой электростанции. При этом она, естественно, тем выше, чем больше дальность транспортировки топлива и чем меньше единичная мощность электростанций.

25. Иное соотношение наблюдается у ядерной энергети-

ки. Вследствие весьма высокой энергоемкости ядерного горючего /малых его об"емов/ затраты на его транспортировку пренебрежимо малы и удельные капиталовложения в предприятия топливного цикла существенно меньше, чем у тепловой энергетики.

В этом одно из перспективных экономических преимуществ ядерной энергетики при широком ее развитии.

26. Естественно, что создание замкнутого топливного цикла в каждой стране, даже располагающей запасами ядерного горючего, вряд ли целесообразно, а в странах, не обладающих необходимым научным и промышленным потенциалом, невозможно. Сотрудничество стран, об"единенными усилиями которых могут быть решены вопросы создания и эксплуатации топливных циклов, могло бы содействовать развитию ядерной энергетики.

27. Различают два направления в создании атомных электростанций: "большую" и "малую" ядерную энергетику. Хотя разделение между ними условное, каждое из них имеет свою специфику.

28. Первое направление преследует цель создания мощных атомных электростанций /порядка несколько сотен Мвт/, экономические показатели которых наиболее благоприятны. Однако такие электростанции целесообразнее использовать для энергоснабжения преимущественно крупных промышленных комплексов. Строительство таких атомных электростанций, не говоря уже о их весьма высокой стоимости, требует хороших транспортных путей и средств для доставки на место громоздкого и тяжелого оборудования, специального строительного оборудования, пред"являет особые требования к площадке сооружения, вынуждает организовывать значительную зону отчуждения и, наконец, ведется в течение нескольких лет. Строительство таких электростанций под силу далеко не всем странам.

29. Второе направление охватывает диапазон электрических мощностей от нескольких тысяч киловатт до максимум нескольких десятков Мвт.

30. Хотя экономические показатели /удельная стоимость и стоимость электроэнергии/ таких электростанций, естественно, несколько хуже, чем у мощных атомных электростанций, строительство атомных электростанций малой мощности может оказаться технически и экономически весьма целесообразным тогда, когда решается вопрос об энергоснабжении отдаленного или труднодоступного пункта или небольшого промышленного центра. В этом случае малая атомная электростанция может оказаться незаменимой, поскольку расходы на нее могут оказаться меньшими, чем расходы, например, на строительство протяженной линии электропередачи в этот пункт/ не говоря уже о потерях электроэнергии/, или чем расходы, связанные с транспортировкой топлива в этот пункт в случае сооружения в нем тепловой электростанции.

31. Малая атомная электростанция в отличие от большой может быть изготовлена в виде компактных, транспортабельных и отлаженных на заводе блоков и собираться на месте сооружения в течение нескольких месяцев. Работы

по проектированию и созданию таких атомных электростанций показали, что они обладают надежностью и безопасностью, небольшим количеством обслуживающего персонала, их сооружение требует минимума строительных и монтажных работ и т.п. Наконец, большая потребность в таких электростанциях является хорошей основой для их серийного выпуска, что является необходимым условием достижения вполне приемлемых экономических показателей.

32. Немаловажным обстоятельством, говорящим в пользу применения малых атомных электростанций в менее развитых районах является то, что по их проектированию, строительству и эксплуатации ядерной энергетикой накоплен наибольший опыт.

33. Таковы, по нашему мнению, некоторые общие аспекты применения ядерной энергетики в менее развитых странах. Что же касается выбора типа реактора для атомной электростанции, то его решение зависит от конкретных условий /в том числе и от возможностей ориентации на тот или иной вид ядерного горючего в данной стране/. Каков бы ни был тип реактора /разумеется, из тех, относительно которых уже имеется опыт/ современная ядерная техника может гарантировать его достаточную надежность и безопасность. Экономические же и технические показатели реакторов могут быть проанализированы и в результате сопоставления различных проектов в каждом конкретном случае могут быть выбраны варианты, позволяющие наиболее рационально использовать природные ресурсы страны с наименьшей затратой труда и средств.

34. При любом варианте развития энергетики в менее развитых странах важнейшей предпосылкой является подготовка высококвалифицированных национальных кадров, способных выбрать наиболее эффективный для данной страны путь развития энергетики и могущие обеспечить строительство и эксплуатацию энергетических и других промышленных предприятий.

492 R - Oct.1962 - 600

E/CONF.39/A/159/Add.1
22 Jan.1963
ORIGINAL : RUSSIAN

КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
ПО ВОПРОСУ О ПРИМЕНЕНИИ НАУЧНЫХ И ТЕХНИЧЕСКИХ ЗНАНИЙ
ДЛЯ УДОВЛЕТВОРЕНИЯ ПОТРЕБНОСТЕЙ МЕНЕЕ РАЗВИТЫХ РАЙОНОВ

И С П Р А В Л Е Н И Е

Просьба принять к сведению следующие исправления, внесенные представившим доклад правительством:

Добавить следующие три чертежа:

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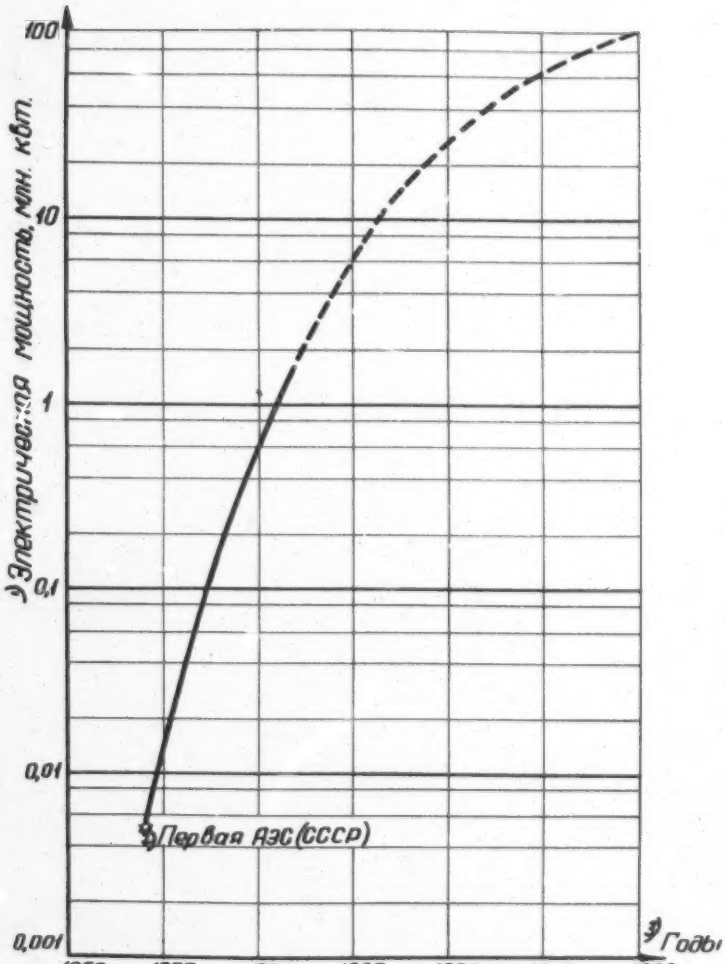
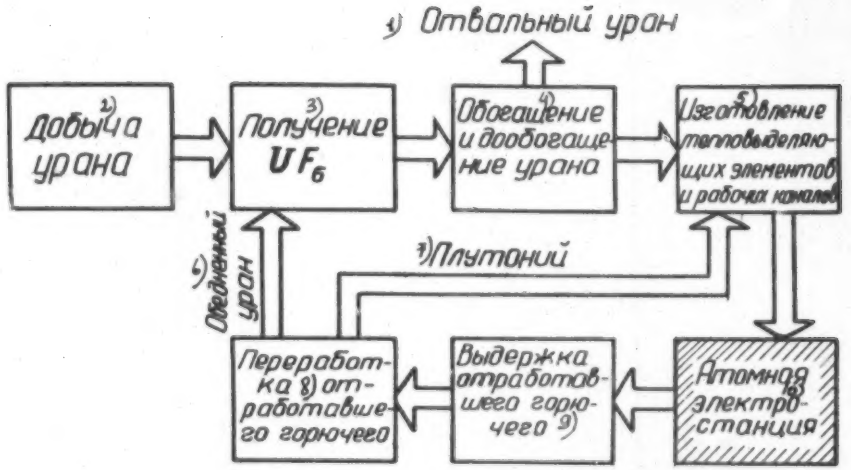
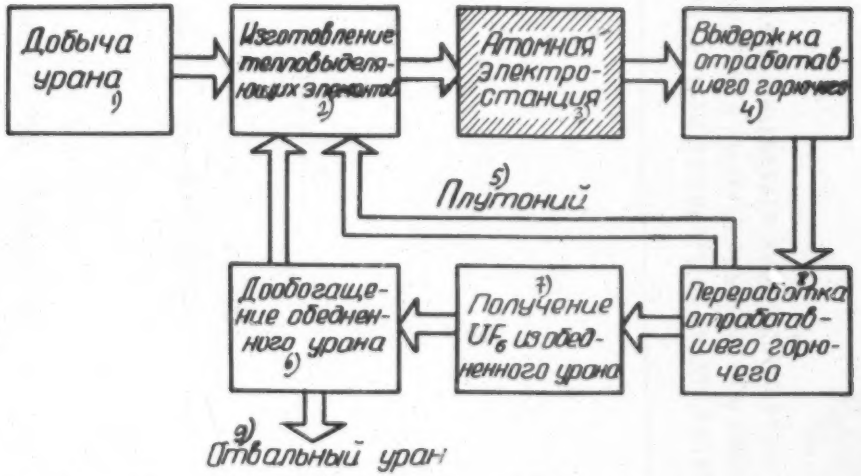


4) Рис. I. Существующий и ожидаемый рост мощностей ядерной энергетики в мире.



11) Рис. II. Топливный цикл ядерной энергетики на обогащенном уране



10) Рис. III Топливный цикл ядерной энергетики на природном уране